



*Delaware
Department
of
Transportation*

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Traffic Controls
for
Streets & Highway
Construction, Maintenance,
Utility & Emergency
Operations

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TRAFFIC CONTROLS FOR STREETS AND HIGHWAYS CONSTRUCTION, MAINTENANCE, AND UTILITY OPERATIONS

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SUBCHAPTER G - ENGINEERING AND TRAFFIC OPERATIONS
PART 630 - PRECONSTRUCTION PROCEDURES

Subpart J - Traffic Safety in Highway and Street Work Zones

Sec.

630.1002	Purpose
630.1004	Background
630.1006	Policy
630.1008	Implementation
630.1010	Contents of the Agency Procedures

AUTHORITY: 23 U.S.C. 109(b), 109(d), 315 and 402(a); 23 CFR 1.48(b), unless otherwise noted.

Sounce: 43 FR 47140, Oct. 12, 1978, unless otherwise noted.

Sec. 630.1004 Purpose

The purpose of this subpart is to provide guidance and establish procedures to assure that adequate consideration is given to motorists, pedestrians, and construction workers on all Federal-aid construction projects.

Sec. 630.1004 Background

Part VI of the Manual of Uniform Traffic Control Devices (MUTCD) sets forth basic principles and prescribes standards for the design, application, installation, and maintenance of the various types of traffic control devices for highway and street construction, maintenance operation, and utility work. The Manual cannot address in depth the variety of situations that occur in providing traffic control in work zones. Although agencies responsible for traffic control and work area protection have attempted to develop some guidelines, a coordinated and comprehensive effort to develop greater uniformity is desirable.

National reviews have shown that more attention is needed to insure that the MUTCD is properly implemented on all highway projects.

(The MUTCD is available from the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402. It is incorporated by reference at 23 CFR 655, Subpart F.) [43 FR 47140, Oct. 12, 1978, as amended at 51 FR 16834, May 7, 1986]

Sec. 630.1006 Policy

It is the policy of the Federal Highway Administration that each highway agency shall develop and implement procedures consonant with the requirements of this regulation that will assure the safety of motorists, pedestrians, and construction workers on Federal-aid highway construction projects. The procedures shall be consistent with the provisions of the MUTCD. Highway agencies should be encouraged to implement these procedures for non-Federal-aid projects and maintenance operations as well.

Sec. 630.1008 Implementation

The FHWA Division Administrator shall review and approve the highway agency's implementation of its procedures at appropriate intervals. The FHWA shall take appropriate action to assure that the highway agency's procedures are being followed and achieve the results intended. Major revision in established procedures shall be submitted to the FHWA Division Administrator for information.

Sec. 630.1010 Contents of the agency procedures.

The agency's procedures shall include, but not necessarily be limited to the following;

(a) Traffic Control Plan (TCP).

(1) A traffic control plan is a plan for handling traffic through a specific highway or street work zone or project. These plans may range in scope from a very detailed TCP designed solely for a specific project, to a reference to standard plans, a section of the MUTCD, or a standard highway agency manual. The degree of detail in the TCP will depend on the project complexity and traffic interference with construction activity.

(2) Traffic control plans shall be developed for all projects and be included in plans, specifications, and estimates (P.S.&E.'s) and shall be consistent with Part VI of the MUTCD.

(3) The scope of the TCP should be determined during the planning and design phases of a project.

(4) Provisions may be made to permit contractors to develop their own TCP's and use them if the highway agency and the FHWA find that these plans are as good as or better than those provided in the P.S.&E..

(5) (i) Two-lane, two-way operation on one roadway of a normally divided highway (TLTWO) shall be used only after careful consideration of other available methods of traffic control. Where the TLTWO is used, the TCP shall include provisions for the separation of opposing traffic except:

(A) Where the TLTWO is located on an urban type street or arterial where operating speeds are low;

(B) Where drivers entering the TLTWO can see the transition back to normal one-way operation on each roadway; or

(C) Where FHWA approved non-use of separation devices based on unusual circumstances.

- (ii) Center line striping, raised pavement markers, and complementary signing, either alone or in combination, are not considered acceptable for separation purposes.
- (b) Responsible Person. The highway agency shall designate a qualified person at the project level who will have primary responsibility and sufficient authority for assuring that the TCP and other safety aspects of the contract are effectively administered. While the project or resident engineer may have this responsibility, on large complex projects another person should be assigned at the project level to handle traffic control on a full time basis.
- (c) Pay Items. The P.S.&E. should include unit pay items for providing, installing, moving, replacing, maintaining, and cleaning traffic control devices required by the TCP. Suitable force account procedures may be utilized for traffic control items. Lump-sum method of payment should be used only to cover very small projects, projects of short duration, contingency, and general items. Payment for traffic control items as incidental to other items of work should be discouraged.
- (d) Training. All persons responsible for the development, design, implementation, and inspection of traffic control shall be adequately trained.
- (e) Process Review and Evaluation
 - (1) A review team consisting of appropriate highway agency personnel shall annually review randomly selected projects throughout its jurisdiction for the purpose of assessing the effectiveness of its procedures. The agency may elect to include an FHWA representative as a member of the team. The results of this review are to be forwarded to the FHWA Division Administrator for review and approval of the highway agency's annual traffic safety effort.
 - (2) Construction zone accidents and accident data shall be analyzed and used to continually correct deficiencies which are found to exist on individual projects, and to improve the content of future traffic control plans.

(23 U.S.C. 109(b), 109(d), 315, and 402(a); 49 CFR 1.48(b))

[43 FR 47140, Oct. 12, 1978, as amended at 47 FR 21780, May 20, 1982]

DELAWARE TRAFFIC CONTROL
A - INTRODUCTION AND GENERAL SPECIFICATIONS

A-1 Need for Standards

In order to have maximum effectiveness, traffic control devices must be applied in a consistent manner to similar type situations. The use of nonstandard devices or the nonstandard use of standard devices may evoke unusual driver behavior.

When traffic must be moved through or around road or street construction, maintenance operations, utility work or any other operation which interferes with normal traffic patterns, problems can occur. Maximum safety for both the road user and the workers can be obtained by providing clear communications for the driver in a logical fashion. The treatment of similar situations in a consistent pattern is the foundation of good communications.

A-2 Scope

This manual sets forth basic principles and prescribes standards for the design, application, installation, and maintenance of the various types of traffic control devices required for all operations which interfere with normal traffic patterns including construction, maintenance or utility operations. For simplicity, the references to these traffic control devices will be to "construction and maintenance" signs, signals, etc. It is understood that the referenced includes all operations of any type which interfere with normal traffic patterns. The traffic control devices include signs, signals, lighting devices, markings, barricades, hand signaling devices, arrowpanels, and dynamic message signs. Minimum standards of application are illustrated for a number of typical situations, and for methods of controlling traffic through work areas.

A-3 Application of Standards

All traffic control devices used on construction, maintenance, or utility work in both rural and urban areas shall conform to the applicable sections of this manual and the National Cooperative Highway Research Program (NCHRP) Report 350 and the memorandum issued August 28, 1998 by the USDOT Federal Highway Administration.

In brief, certification of compliance with NCHRP Report 350 is required for the following categories of traffic control devices:

Category I contains small and lightweight channelizing and delineating control devices which includes cones, tubular markers, flexible delineator post and drums, all without any accessories or attachments.

Category II includes traffic control devices that are not expected to produce significant vehicular velocity changes to impacting vehicles. These devices, which shall weigh 100 lbs (45 kg) or less, include Type I, II, and III barricades, portable sign supports with signs, and intrusion alarms. Also included are drums, cones, and vertical panels with accessories or attachments.

Category III includes traffic control devices that are expected to cause significant vehicular velocity changes to impacting vehicles. These devices, which usually weigh more than 100 lbs (45 kg), include temporary barrier, temporary impact attenuators, and truck-mounted attenuators.

Category IV includes portable or trailer-mounted devices, such as arrow panels, variable message signs, temporary traffic signals, and temporary area lighting.

The schedule for implementation of certification is as follows:

Category I – Effective October 1, 1998, all devices shall be certified as conforming to NCHRP Report 350 criteria.

Category II – Effective October 1, 2000, all new devices shall be certified as conforming to NCHRP Report 350 criteria. Prior to October 1, 2002, devices acquired before October 1, 2000 that have not been crash tested in accordance with NCHRP Report 350 criteria can be used provided that it can be certified that the devices were acquired prior to October 1, 2000. Effective October 1, 2002, all devices shall be certified as conforming to NCHRP Report 350 criteria.

Category III – Effective October 1, 1998, all impact attenuators shall be certified as conforming to NCHRP Report 350 criteria.

Category III – Effective October 1, 2000, all temporary barrier devices shall have tensile and moment resistance. After October 1, 2002, all new temporary barrier devices shall be certified as conforming to NCHRP Report 350 criteria.

Category IV – Certification of compliance to NCHRP Report 350 criteria is not required.

For DelDOT administered projects, the certification shall be submitted to the Engineer prior to installation of use of traffic control devices. For Category I devices, the manufacturer or owner may self-certify that the devices meet NCHRP Report 350 criteria. For Category II and Category III devices, the contractor shall supply the Federal Highway Administration's NCHRP Report 350 acceptance letter for each type of device.

NCHRP Report 350 certified traffic control devices are required for all other activities occurring on or within all highways open to public travel within this State. It is the responsibility of the device owner or user to insure that all traffic control devices meet the above requirements. Unless specified above, it is the traffic control device owner or user's responsibility to retain copies of certification documents. To validate device certification, these documents must be available for inspection by the Chief Traffic Engineer or his/her designee.

Since it is not practical to prescribe detailed standards of application for all the situations that may conceivably arise, the standards presented here are for the most common situations. It is emphasized that these are standards for normal situations. Additional protection must be provided when special complexities and hazards prevail. Less protection may be warranted under special conditions as well. The variety of conditions encountered makes the establishment of inflexible arrangements totally impractical. Nothing in this manual shall be interpreted as precluding the application of engineering judgement. In all questions of interpretations, the judgement of the Chief Traffic Engineer shall be final. The protection prescribed for each situation shall be based on the speed and volume of traffic, duration of operation and exposure to hazards. The term street refers to all the streets in any municipality, including cities, towns, villages, or other local jurisdictions.

A-4 Responsibility

These standards have been adopted by the Delaware Department of Transportation as provided for in Title 17, of the laws of Delaware. These standards are incorporated into the specifications for all Department of Transportation contracts.

Therefore, traffic control devices shall be maintained and shall not be removed or altered in any way without the authority of the Traffic Engineer. The provisions for public, pedestrian and worker protection established herein are for application by (1) Department of Highways, County Utility and Municipal forces performing construction or maintenance operation on roads or streets, (2) Contractors employed in road or street construction or maintenance under contract to any governmental authority, and (3) all other, including employee and contractor working for public or private Utility companies, fire department and enforcement officer, performing any operation on highway or so closely adjacent as to create hazard for the public or for themselves.

On projects where the reflectorized device is to remain in place not more than 7 calendar days, the photometric brightness values may be as low as 70% of the values stated in the referenced specification. In all cases where the measured brightness is 60% or less than the referenced specifications reflectorized device is no longer considered reflectorized and shall be illuminated or removed from the work site. Illumination here refers to providing sufficient ambient light from roadway lighting to compensate for lost reflectivity.

A-5 Incident Management

Incident Management operations on rural and urban highways are diverse, involving responses to fires, accidents, stalled vehicles, fallen power lines, etc. They often must be carried out under difficult lighting, weather and traffic conditions.

All traffic control devices used on streets and highways construction, utility, maintenance, and incident management operations shall conform to the applicable specifications of this manual.

A traffic control plan, in detail appropriate to the complexity of the work project or incident, should be prepared and understood by all responsible parties before the site is occupied. Any changes in the traffic control plan should be approved by an official trained in safe traffic control practices.

A-6 Traffic Control Plans The Traffic Control Plans present a concept of the relationship between roadway construction or maintenance work and traffic control. Any revision to the details or sequence of work shall require a revised traffic control plan. The revised traffic control plan shall be prepared in accordance with the current revisions to this manual. The contractor shall note that revisions to the traffic control plans, as well as review time by DelDOT, shall not justify a delay in the construction schedule. All costs involved in preparing the plan revision documents shall be the responsibility of the contractor.

A-7 Training

Each person whose actions affect construction, maintenance, utility and incident management zone safety, from the upper-level management personnel through field personnel, should receive training appropriate to the job decisions each individual is required to make. Only those individuals who are qualified by means of adequate training in safe traffic control practices and have a basic understanding of the principles established by applicable standard and regulations, including those of the manual, should supervise the selection, placement, and maintenance of traffic control devices in work and incident management areas. An ATSSA certified work site supervisor meets all of these training requirements.

B - SIGNS (GENERAL)

B-1 Design of Signs

Street or highway construction, maintenance, and utility signs fall into the same three major categories as do other traffic signs; namely, Regulatory, Warning, and Guide Signs. Many signs normally used elsewhere will also find application for road or street work. Special construction and maintenance signs follow the basic standards for all highway signs as to shape. The sign colors are as prescribes in the design of respective signs. Warning signs for work areas described herein shall have a Black legend on an Orange background to accentuate these hazardous areas. Existing Yellow warning signs already in place within these areas may remain in use unless otherwise directed by the Traffic Engineer.

The use of stripes (other than the standard border) or other geometric patterns or contrasting colors on or around any sign in an attempt to make it more conspicuous, distracts attention from the message, and defeats the purpose of maintaining uniformity and simplicity of design. Such practice is contrary to standards and is accordingly disapproved. The use of standard Orange flags or flashing lights in conjunction with signs is permitted, so long as they do not interfere with a clear view of the sign face.

The dimensions of the signs shown herein are for standard sizes, which may be increased wherever necessary for greater legibility or emphasis. On secondary highways and city streets, smaller signs may be used if authorized. Deviations from standard sizes as prescribed herein shall be in six-inch increments. All signs shall have rounded corners with a minimum 1.5" radius.

*

Standard sign sizes and colors are shown in the illustrations of the individual signs rather than in detailed specifications in the text. All signs shall be made of an NCHRP 350 approved substrate, except wood, with reflective sheeting meeting the following specifications.

Reflective Sheeting Specifications

The reflective sheeting shall consist of a retroreflective lens system having a smooth outer surface. The sheeting shall be weather resistant and have a protected precoated adhesive backing.

Sheeting is divided into three categories of sign sheeting:

1. Hi-Intensity
2. Extra Grade
3. Temporary Flexible Warning Sign

All traffic control devices requiring reflective sheeting shall have, as a minimum, "Hi-Intensity" sheeting. "Extra Grade" shall be used where specified and may be used in lieu of "Hi-Intensity" on other devices.

"Hi-Intensity"

Reflective sheeting that meets ASTM D4956-99 Type III requirements shall be used where "Hi-Intensity" requirements are specified. The following minimum coefficient of retroreflection (RA) table applies:

Type III Sheeting

Observation Angle Deg.	Entrance Angle Deg	White	Yellow	Orange	Green	Red	Blue	Brown
0.1	- 4	300	200	120	54	54	24	14
0.1	+30	180	120	72	32	32	14	10
0.2	- 4	250	170	100	45	45	20	12
0.2	+30	150	100	60	25	25	11	8.5
0.5	- 4	95	62	30	15	15	7.5	5
0.5	+30	65	45	25	10	10	6	3.5

"Extra Grade"

Reflective sheeting that meets the following "Minimum Coefficient of Retroreflection" (RA) shall be used where "Extra Grade" requirements are specified.

Further, the sheeting must be approved by DelDOT.

The two current approved sheeting are:

1. 3M "Diamond Grade"
2. Stimsonite "6200 Prismatic"
- * 3. Reflexite Endurance

Observation Angle Deg.	Entrance Angle Deg	White	Yellow	Orange	Green	Red	Blue	Brown
0.1	4	850	675	400	85	200	45	34
	30	400	350	160	40	74	22	14

Temporary Flexible Warning Sign Sheeting

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Temporary Flexible Warning Sign Sheeting shall be made from materials that will meet, as a minimum, the “Hi-Intensity” specifications for reflectivity. If the signs are for nighttime use, the sign sheeting shall be made from materials that they meet, as a minimum, the “Extra Grade” specification for reflectivity. These sign blanks shall be suitable for making maintenance, utility, and construction signs which meet all the requirements of the Manual on Uniform Traffic Control Devices. These are commonly referred to as roll-up signs.

B-2 Position of Signs

Signs shall be placed in positions where they will convey their message most effectively and placement must, therefore, be accommodated to highway design and alignment. Signs shall be so placed that the driver will have adequate time for response.

As a general rule, signs shall be located on the right-hand side of the street or roadway. It may be necessary or desirable at times to erect signs on the left-hand side only. The engineer shall make this determination. Where special emphasis is deemed necessary, (dual highways where the median is wide enough to permit installation of signs) dual installations shall be made which consist of duplicate signs opposite each other on the left and right sides of the roadway, respectively. Within a construction, maintenance or utility area, however, it is often necessary and/or desirable to erect signs on temporary portable supports placed within the roadway itself.

Signs erected on posts at the side of any roadway for the purpose of warning an approaching motorist of a lane closure or roadway obstruction shall be mounted at a height of at least seven (7) feet measured from the bottom of the sign to the near edge of the pavement. Signs erected on skids or other temporary supports shall be mounted at a height of at least five(5) feet measured from the bottom of the sign to the near edge of the pavement (see Page 99).

Signs may also be mounted on barricades when approved, however, they shall be mounted at a height of not less than two (2) feet. All measurements are from the bottom of the sign to the pavement level.

Where open highway conditions prevail on the approach to the work site, advance warning signs shall be placed approximately 1,500 feet in advance of the work site. The warning sign nearest the work site shall be placed approximately 500 feet from the point of restriction with the additional signs at 500-1,000 foot intervals. On expressway and limited access facilities the advance warning distance shall be increased to one-half mile. On city streets where more restrictive conditions generally prevail on the approach to the work area, signs in the immediate vicinity of the work may be placed at closer spacing. Typical sequence and spacing of advance warning signs are shown in Cases located at the back of this Manual.

B-3 Erection of Signs

Signs on fixed supports are usually mounted on a single post, although those wider than thirty-six (36) inches or larger than ten (10) square feet shall be mounted on two (2) posts. The post(s) used must meet Federal breakaway standards unless located behind barrier or guardrail. Signs mounted on portable supports are suitable for temporary conditions as approved by the Chief Traffic Engineer or his authorized representative. Skids and collapsible metal sign supports are typical portable supports. These portable supports will need to comply with the new FHWA NCHRP-350 standards once adopted. All such installations shall be so constructed to yield upon impact to minimize hazard to motorists. Weights used to stabilize the supports shall be placed less than twelve (12) inches above the surface. For maximum mobility on certain types of maintenance operation, a larger sign may be effectively mounted on a vehicle stationed in advance of the work or moving along with it. This may be the working vehicle itself, as in the case of pavement marking equipment, or a vehicle provided expressly for this purpose. Guide signs, although ordinarily erected on separate posts, may also be mounted on or above barricades, but shall not be permitted to interfere with the effectiveness of necessary regulatory and warning signs.

REGULATORY SIGNS

B-4 Authority

Regulatory signs impose legal obligations and/or restrictions on all road users. It is mandatory that their use be authorized by the Department of Transportation or the City Council having jurisdiction and that signs conform with this Manual and the Delaware Manual on Uniform Traffic Control Devices for Streets and Highways.

B-5 Design

Regulatory signs are generally rectangular with their longer dimension vertical, and carry a Black legend and border on a White background. The Stop sign is octagonal, and has a White legend on a Red background. The Yield sign is a White inverted triangle with Red legend and border band. The Do Not Enter sign consists of a White Square on which is inscribed a Red circle with a White band horizontally across the center of the circle and the words Do Not Enter in White letters on the upper and lower parts of the circle. The One Way sign may be either horizontal or vertical plate, the latter being used more commonly in the city where space is limited. Other commonly used regulatory signs are illustrated.

B-6 Application

Construction, maintenance and utility operations represent unusual roadway conditions and warrant special attention. If construction, maintenance or utility operations require regulatory measures different from those normally in effect, the existing permanent regulatory devices shall be removed or covered and superseded by the appropriate temporary regulatory sign, taking into account applicable ordinances or statutes.

B-6A Permanent Sign

Permanent Sign are post mounted where possible. These signs are placed in the advance of the Construction or Utility area. Such as but not limited to Road Work, End Road Work, Fines Doubled in Work Zone, Road Closed, Detour, and advisory speed plate. Most of these signs are placed at the start of the project and remain in place until the project is accepted or completed.

B-6B Temporary Sign

Temporary signs are signs placed for but not limited to Closure, Flagger, Shoulder Closed, Truck Crossing, Uneven Pavement Joint, Workers, Utility Work Ahead, One Lane Road, and Blasting Zone. Temporary Signs are used in day to day operations, such as: Lane Closed, Shoulder Work, so work can be performed safely while traffic continues to flow.

B-7 Road (Street Closed Sign), Bridge, or Railroad (R11-2)

- A. **Justification** The Road, Bridge, or Railroad (Street) Closed sign shall be used where the roadway is closed to all traffic except contractor's equipment and officially authorized vehicles and shall be accompanied by appropriate detour signing.
- B. **Placement** The sign shall be erected at or near the center of the roadway on or above a Type III barricade. Red, Type B high intensity-flashing warning lights shall be mounted on and above the barricade. For daylight operations only, a flagger may be used in place of the flashing red lights.
- C. **Size** Because it is the last sign the driver will see before he must stop or turn, it is essential that it be large and legible. It shall have a minimum size of (48) inches by (30) inches.

SIGN SIZE	SERIES		MAR- GIN	BOR- DER	DIMENSIONS							
	LINES				A	B	C	D	E	F	G	H
	1	2										
48x30	D	D	1/2	3/4	48	30	5	8	4	13 1/4	13 1/2	19



COLOR: Black Legend and Border on White Reflectorized Background.

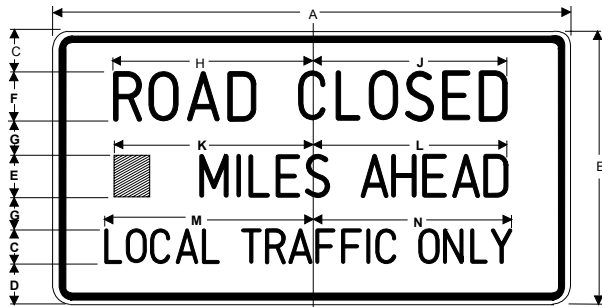
(R11-2)

The Road, Bridge, and Railroad (Street) Closed sign shall not be used where traffic is maintained or where the actual closure is some distance beyond the sign and local traffic is permitted access to nearer points. In the latter case, the Local Traffic Only sign (R11-4) or (R11-3) shall be used.

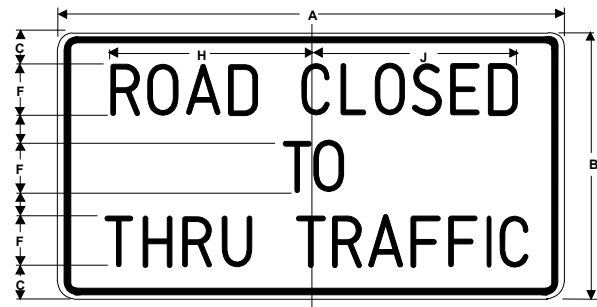
B-8 Local Traffic Only Signs (R11-3), (R11-4)

- A. Justification The Local Traffic Only sign shall be used where through traffic must detour to avoid a closing of the road or street some distance beyond; but where the road or street is open for traffic up to the point of closure, it shall carry the legend Road Closed XXX Miles Ahead - Local Traffic Only or, optionally for urban use, Road Closed to Thru Traffic. The words The Bridge Out shall be substituted for Road Closed where applicable.
- B. Placement It shall be erected on or above a Type III Barricade in the right lane of the roadway at the last intersection where traffic must detour, and shall be accompanied by appropriate detour signing. Type B flashing warning lights shall be installed on and above the barricade during all nighttime closures. (See Section D) For daylight operations only, a flagman may be used in place of the flashing lights.
- C. Size It shall have a minimum size of (60) inches by (30) inches.

SIGN SIZE	SERIES			MAR- GIN	BOR- DER	DIMENSIONS												
	LINES					A	B	C	D	E	F	G	H	J	K	L	M	N
	1	2	3															
60x30	C	C	C	1/2	3/4	60	30	4	4 1/4	5	6	3 3/8	2 15/16	22 3/8	21 3/8	22 1/4	24 1/8	24 1/2



(R11-3)



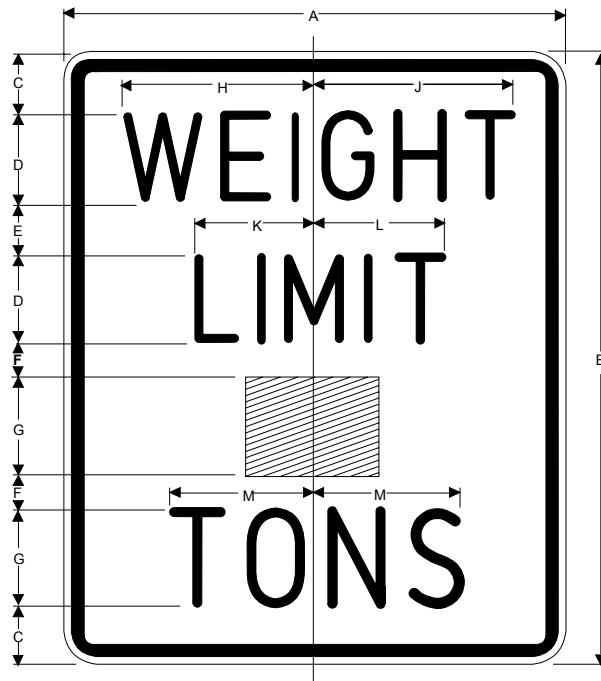
(R11-4)

COLOR: Black Legend and Border on White Reflectorized Background.

B-9 Weight Limit Signs (R-12 Series)

- A. Justification A weight limit sign shows the Gross Weight or Axle Weight that can be permitted on a roadway surface or bridge. Weight restrictions shall not be imposed without the approval of the Department. The Traffic Engineer may require a marked detour route for vehicles whose legal weight exceeds the limit posted.
- B. Placement It shall be located immediately in advance of the section of highway or the structure to which it applies. In the case of an extended length of restricted road. It should be placed on the right-hand side of the restricted roadway not more than (25) feet beyond any intersecting road on which the restriction does not apply, so as to be clearly visible from all vehicles about to enter the restricted roadway. A supplementary sign may be desirable on the left hand side of the roadway.
- C. Size It shall have a minimum size of (24) inches by (30) inches.

SIGN SIZE	SERIES LINES				MAR- GIN	BOR- DER	DIMENSIONS											
	1	2	3	4			A	B	C	D	E	F	G	H	J	K	L	M
24x30	D	D	E	D	3/8	5/8	24	30	3 1/8	4	1 7/8	2 3/16	5	8 5/8	9 5/16	6 3/16	6 5/8	9
36x48	D	D	E	D	1/2	3/4	36	48	5	6	3	3 1/2	8	13	14	9 1/4	10	13 1/2

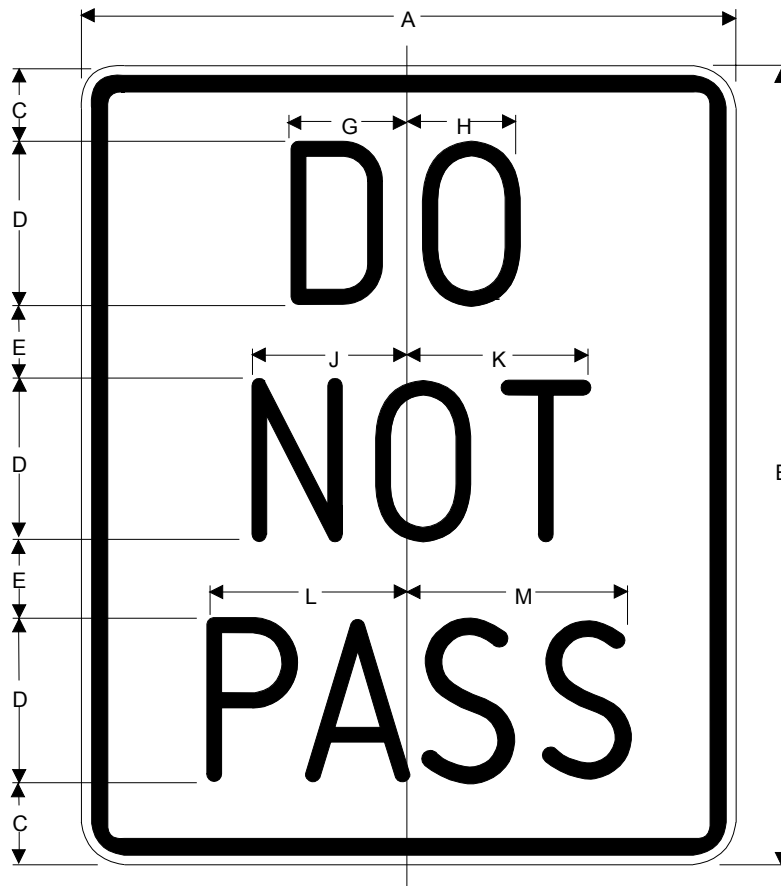


COLOR: Black Legend and Border on White Reflectorized Background.
(R-12 SERIES)

B-10 Do Not Pass Sign (R4-1)

- A. Placement The Do Not Pass sign may be used on a two or three lane highway at the beginning of, and at intervals within, a zone through which restricted sight distance or other condition makes overtaking and passing hazardous.
- B. Size It shall have a minimum size of (24) inches by (30) inches.

SIGN SIZE	SERIES LINES			MAR- GIN	BOR- DER	DIMENSIONS											
	1	2	3			A	B	C	D	E	F	G	H	J	K	L	M
24x30	D	D	D	3/8	5/8	24	30	3 3/8	6	2 1/2	3 5/8	4 11/16	4 7/8	7	7 1/4	9 5/16	9 1/2
36x48	D	D	D	1/2	3/4	36	48	5 1/2	10	3 1/2	5 1/2	7 7/8	7 7/8	11 1/2	11 3/4	14 3/4	14 3/4



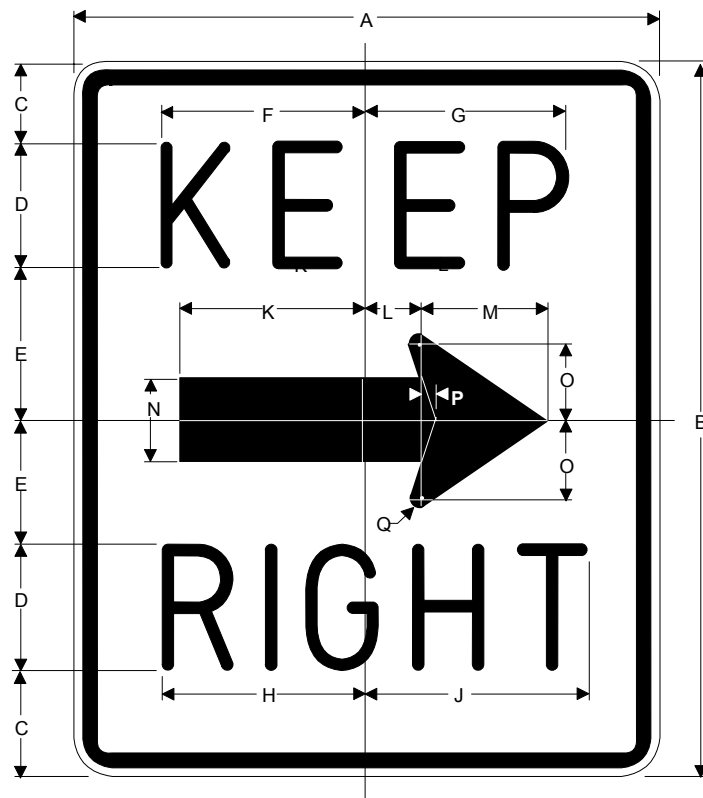
COLOR: Black Legend and Border on White Reflectorized Background.

(R4-1)

B-11 Keep Right Sign (R4-4R)

- A. Placement The Keep Right Sign should be used on tapers, etc., where traffic is required to keep to the right.
- B. Size It shall have a minimum size of (24) inches by (30) inches.

SIGN SIZE	SERIES		MAR- GIN	BOR- DER	DIMENSIONS															
	LINES				A	B	C	D	E	F	G	H	J	K	L	M	N	O	P	Q
	1	2																		
24x30	D	D	3/8	5/8	24	30	4 1/2	5	5 1/2	8 1/16	8 3/4	7 3/16	7 1/2	7 1/8	2 1/4	5 1/4	2 1/2	3	3/8	1/2
36x48	D	D	1/2	3/4	36	48	7 1/2	8	8 1/2	12 1/2	12 1/2	11 1/2	12	12	3	9	4 1/2	5 1/4	1/2	3/4



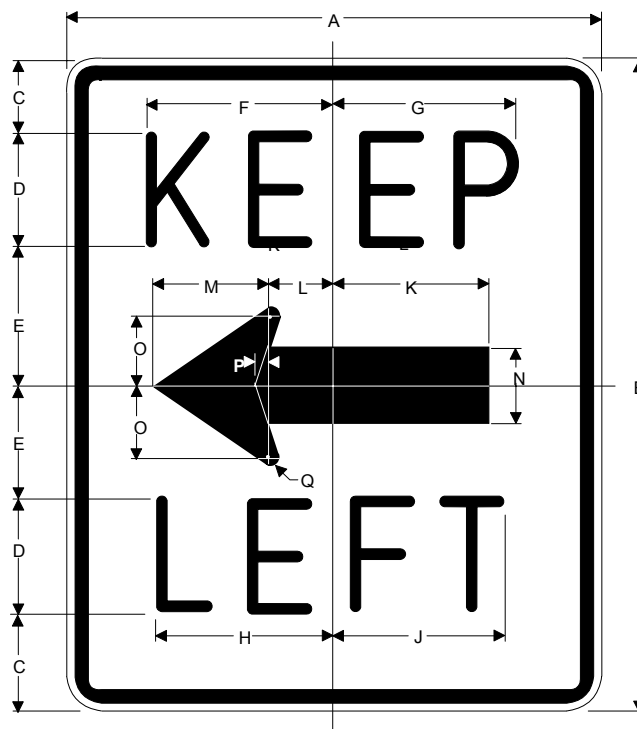
COLOR: Black Legend and Border on White Reflectorized Background.

(R4-7a)

B-12 Keep Left Sign (R4-4L)

- A. Placement The Keep Left sign should be used on tapers etc. where traffic is required to keep to the left.
- B. Size It shall have a minimum size of (24) inches by (30) inches.

SIGN SIZE	SERIES		MAR- GIN	BOR- DER	DIMENSIONS																
	LINES				A	B	C	D	E	F	G	H	J	K	L	M	N	O	P	Q	
	1	2																			
24x30	D	D	5/8	5/8	24	30	4 1/2	5	5 1/2	8 1/16	8 3/4	9 1/2	9 11/16	7 1/8	2 1/4	5 1/4	2 5/8	3	3/8	1/2	
36x48	D	D	1/2	3/4	36	48	7 1/2	8	6 1/2	12 1/2	12 1/2	14	14	12	3	9	4 1/2	3 1/4	1/2	3/4	



COLOR: Black Legend and Border on White Reflectorized Background.

(R4-8a)

B-13 Special Regulatory Signs

Various other regulatory signs may be called for by special operations in or around the roadway. Although it is not practicable to standardize many such signs in detail, they shall conform to the general requirements pertaining to color and shape. Their messages shall be brief, legible, and clearly understandable. Typical examples are: KEEP OFF WET PAINT; NO RADIO TRANSMISSION; and NO STOPPING.

WARNING SIGNS

B-14 Function

Warning signs are used to notify drivers of specific hazards associated with construction, maintenance or utility operations. Within the work zone there may be a variety of temporary roadway facilities. Pavement width may be reduced. Open excavations may be present in or near the roadway, or travel across an unpaved section may be required. Drivers must be properly alerted to possible dangers ahead.

B-15 Design and Application

Warning signs shall be diamond shaped (square with one diagonal vertical), having a black symbol or message and border on an orange background, except as provided for herein.

Construction, maintenance or utility operations on freeway or expressway facilities, may also require large movable warning signs. Mounting considerations for some of these signs may justify a change from the standard diamond shape to a rectangular shape, but such variances must have prior approval of the Chief Traffic Engineer.

Detailed specifications are given only for signs prescribed for construction, maintenance and utility work and for some of the standard signs that are commonly required for these work areas.

The standard size of warning signs shall be as shown with the sign illustrations herein. Where not otherwise noted, signs shall be 48 inches by 48 inches.

Where any part of the roadway is obstructed or closed, approach warning signs are required to alert traffic well in advance of these obstructions or restrictions to normal traffic flow. Because of their importance, these signs shall have a standard size of 48 inches by 48 inches, and shall be the standard diamond shape for warning signs, except as provided herein.

Where speeds and volumes are relatively low, a minimum size of 36 inches by 36 inches may be used for Approach Warning Signs, provided that a minimum letter size of 5 inches can be accommodated on this size with the appropriate legend.

B-16 Application of Construction Approach Warning Signs

The determination of the sign or signs to be used shall be on the basis of an engineering study. A set of recommended practices is included in this manual. All of these are considered typical and subject to additions or deletions as considered necessary by the engineer. As an alternate to the specific distances on the advance warning signs, the word "AHEAD" may be used when authorized by the Traffic Engineer.

TEMPORARY FLEXIBLE WARNING SIGNS

B-17 Use and Application of Temporary Flexible Warning Signs

Flexible signs, which conform to all the requirements set forth by this manual for warning signs, may be displayed in lieu of standard warning signs within construction, maintenance and utility zones under the following conditions.

It is intended that the application of all such signs be used only for temporary and/or emergency situations. Placement of temporary flexible warning signs shall not exceed a period of twenty four (24) hours in each individual instance.

B-17-A Flags

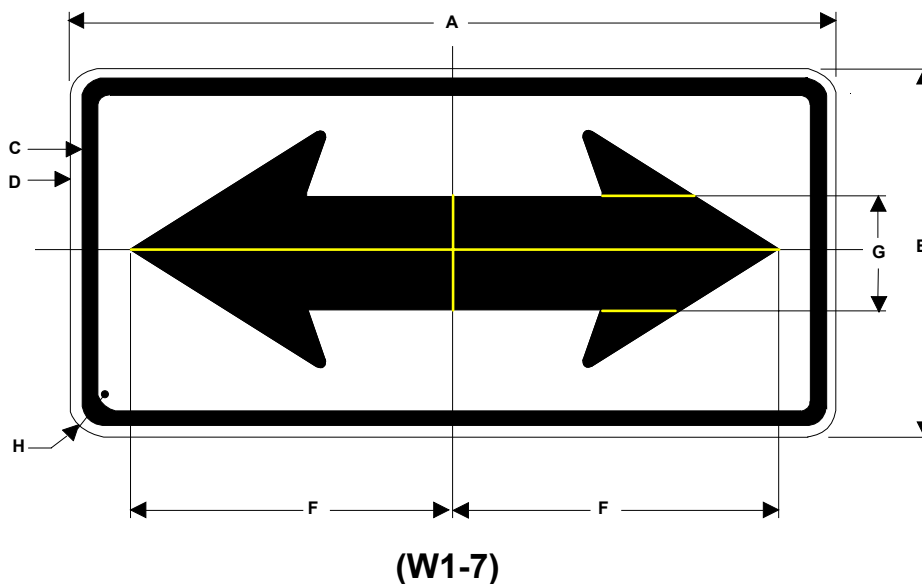
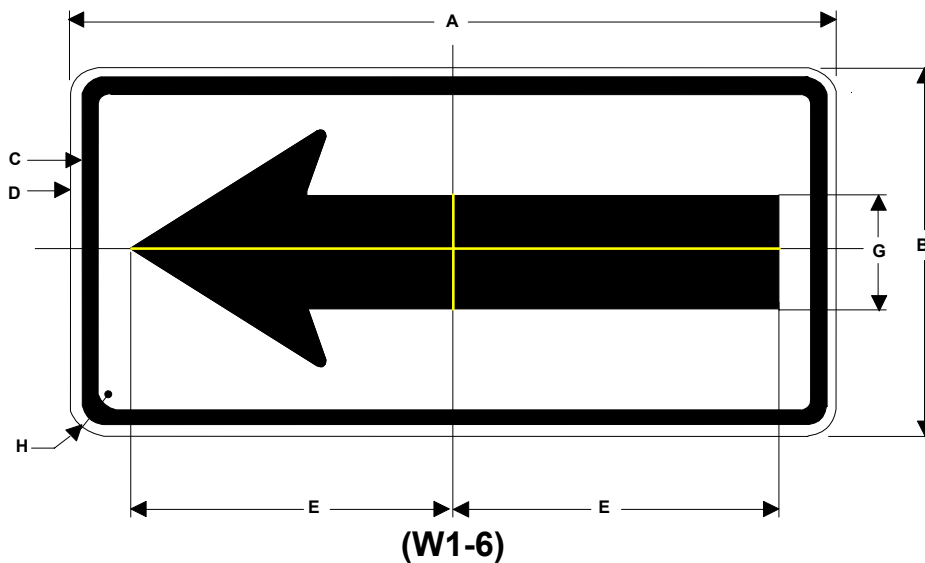
Flags used for flagging and installed on signs must be twenty-four(24) inches x twenty-four(24) inches on a three(3) foot standard, the material can be plastic or cloth; open mesh flags are not acceptable.

B-18 Large Arrow (W1-6,7)

- A. Justification The sign is intended for use where there is an abrupt change in the direction of traffic.
- B. Placement It shall be placed on the outside of a curve, on a turn, or on the far side of a "T" intersection, in line with and at a right angles to approaching traffic.
- C. Size It shall have a minimum size of (48) inches by (24) inches.

COLOR: Black legend and border on an orange reflectorized background.

SIGN	DIMENSIONS							
	A	B	C	D	E	F	G	H
STD.	48	24	1/2	3/4	19 1/2	20 1/2	6 1/2	1 7/8
SPECIAL	60	30	5/8	7/8	24 3/8	25 3/8	8	2 1/4



B-19 Advance Road or Utility Work Sign (W20-1)(-)

A. Justification

The advance work sign shall be used in advance as a general warning of obstructions or restrictions a driver may encounter. It carries the legend Road or Utility Work _____. The word UTILITY may replace the word ROAD when pertaining to utility operations.

B. Placement

It may be used in repetition with appropriate legends or in conjunction with other construction signs. Distances shall be adjusted to the prevailing speed and traffic volume on the approaching roadway.

C. Size

It shall have a minimum size of (48) inches, by (48) inches, except as provided for herein (Section B).

B-20 Advance Detour Sign (W20-2)(-)

A. Justification

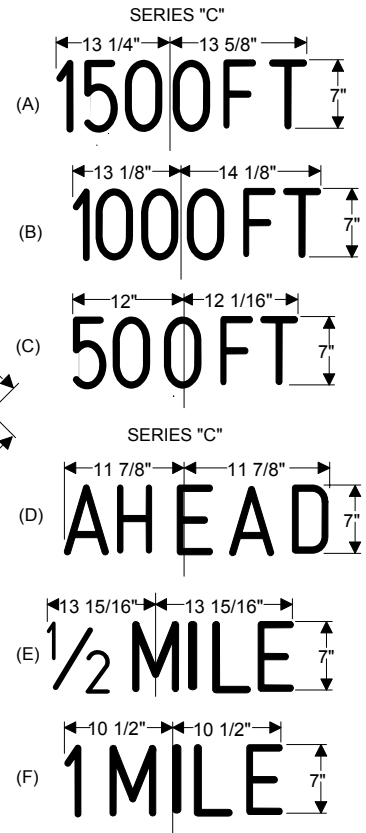
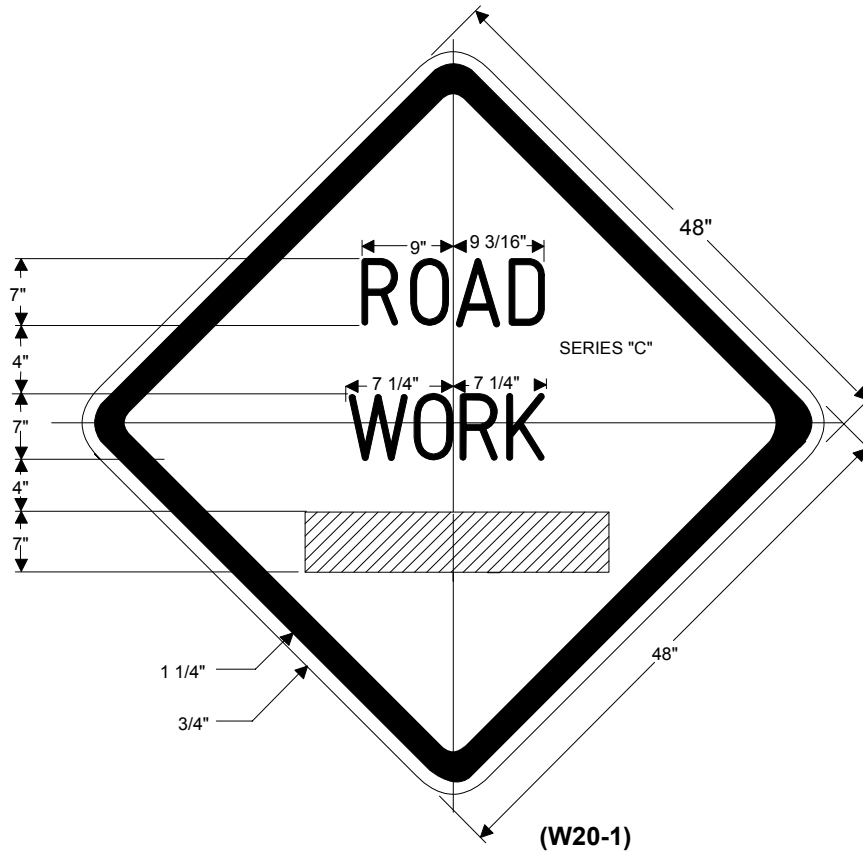
The advance detour sign shall be used in advance of a point at which traffic is diverted over a temporary roadway or route. It carries the legend Detour _____.

B. Placement

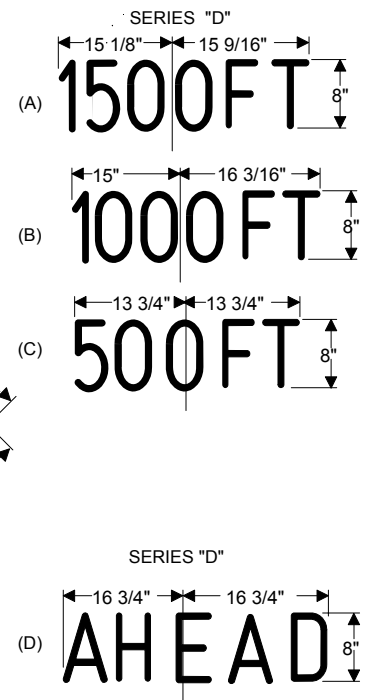
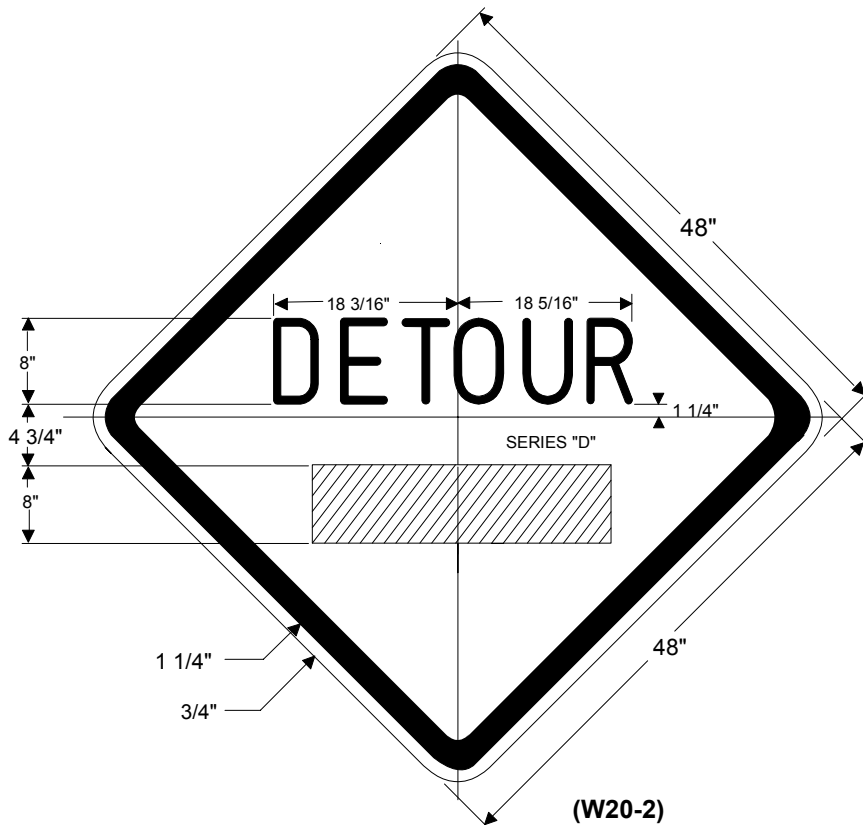
It may be used in repetition with appropriate legends or in conjunction with other construction signs. Distances shall be adjusted to the prevailing speed and traffic volume on the approaching roadway.

C. Size

It shall have a minimum size of (48) inches by (48) inches, except as provided for herein (Section B).



COLOR: Black legend and border on an orange reflectorized background.



B-21 Advance Road Closed Sign (W20-3)(-)

A. Justification

The advance road closed sign shall be used in advance of a point at which a roadway is closed to all but local traffic. It carries the legend Road Closed_____.

B. Placement

It may be used in repetition with appropriate legends or in conjunction with other construction signs. Distances shall be adjusted to the prevailing speed and traffic volume on the approaching roadway.

C. Size

It shall have a minimum size of (48) inches by (48) inches, except as provided for herein (Section B).

B-22 Advance One Lane Road Sign (W20-4)(-)

A. Justification

The advance one lane road sign shall be used in advance of a point where traffic in both directions must be a single lane. It carries the legend One Lane Road _____.

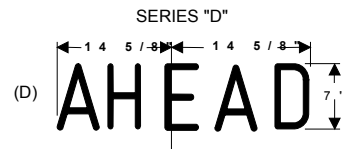
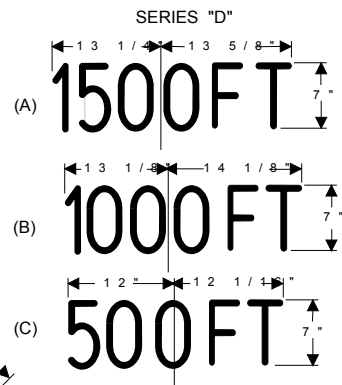
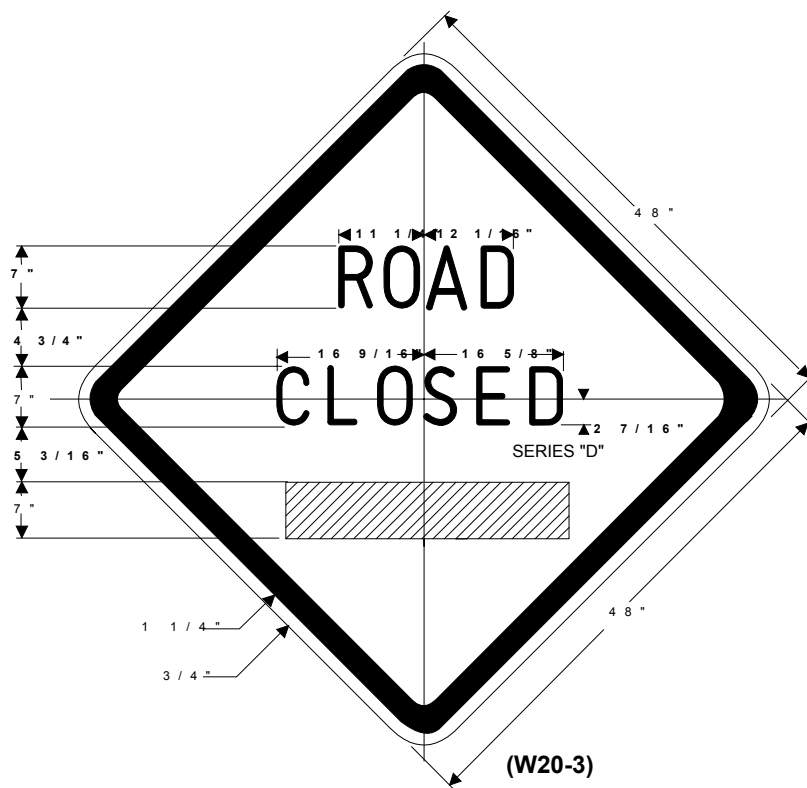
B. Placement

It may be used in repetition with appropriate legends or in conjunction with other construction signs. Distances shall be adjusted to the prevailing speed and traffic volume on the approaching roadway.

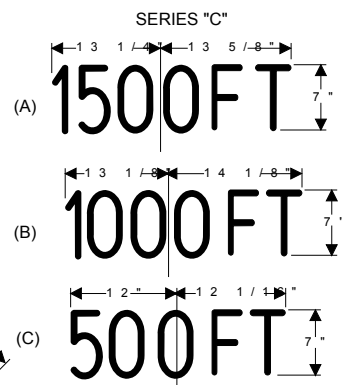
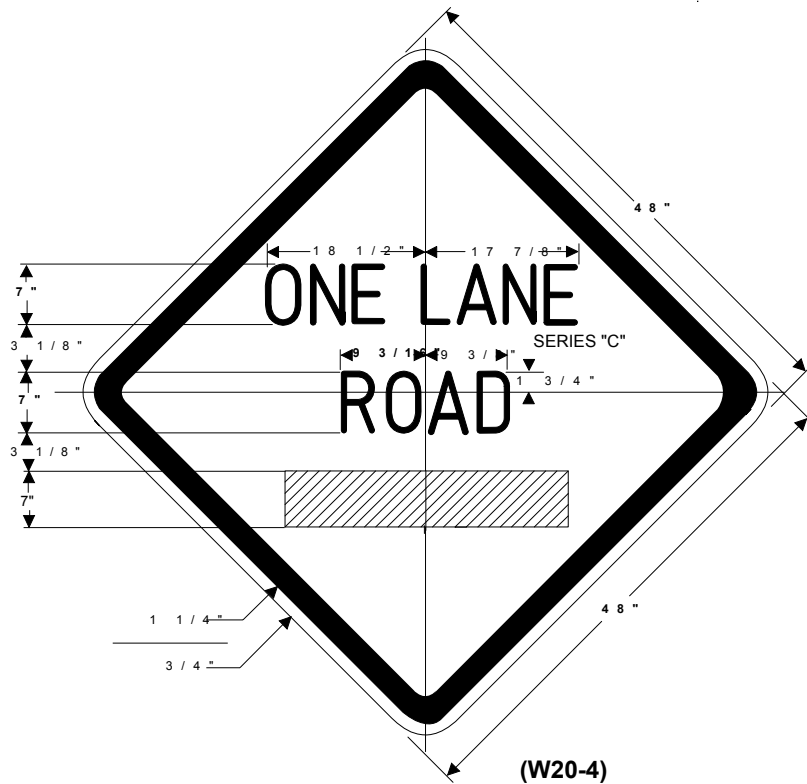
If the one-lane stretch is of such length as not to be visible throughout from either end, or if the traffic is of such volume that simultaneous arrivals at both ends occur frequently, provision must be made to permit traffic to move under additional control.

C. Size

It shall have a minimum size of (48) inches, by (48) inches, except as provided for herein (Section B).



COLOR: Black legend and border on an orange reflectorized background.



B-23 Advance Lane Closed Sign (W20-5)(-)

A. Justification

The advance lane closed sign shall be used in advance of a point where one lane of a multiple-lane roadway is closed. It carries the legend Right (Left, Center, or This) Lane Closed_____.

B. Placement

It may be used in repetition with appropriate legends or in conjunction with other construction signs. Distances shall be adjusted to the prevailing speed and traffic volume on the approaching roadway.

C. Size

It shall have minimum size of (48) inches by (48) inches, except as provided for herein (Section B).

B-24 Advance Merge Sign (W20-6)(-)

A. Justification

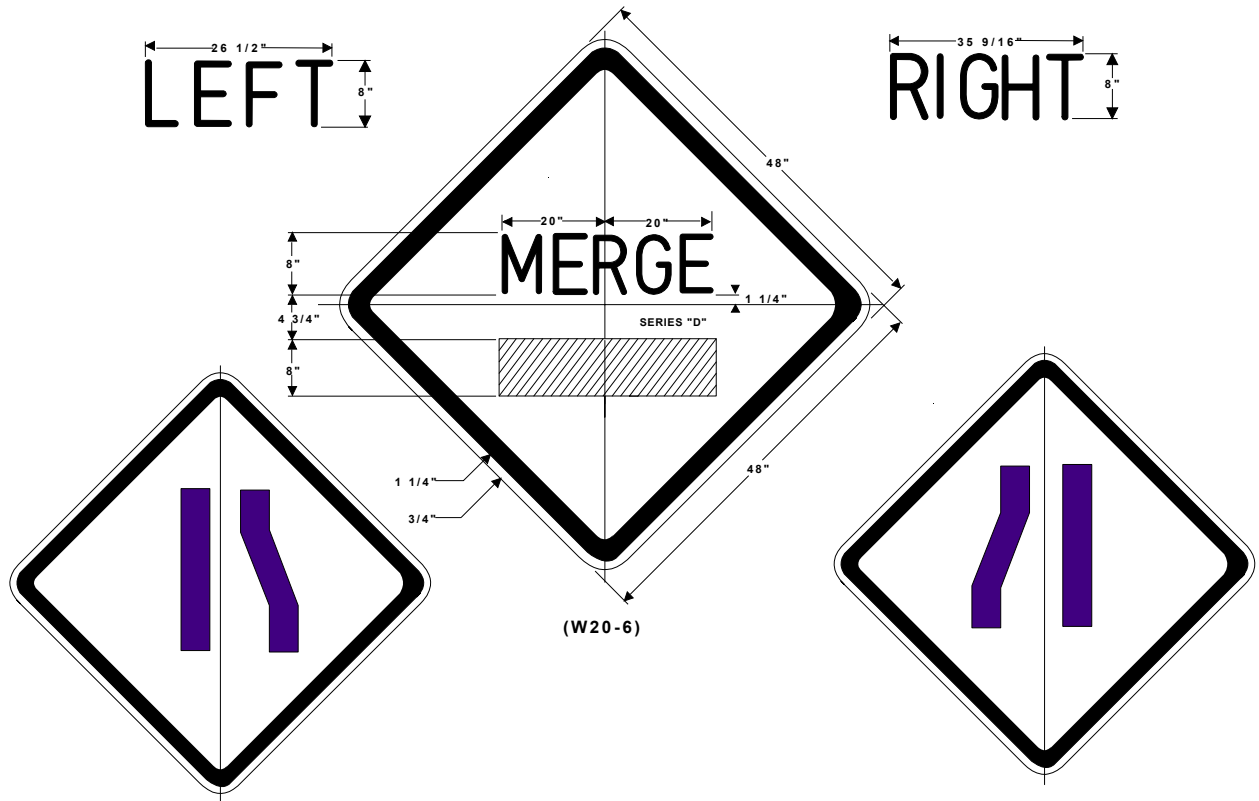
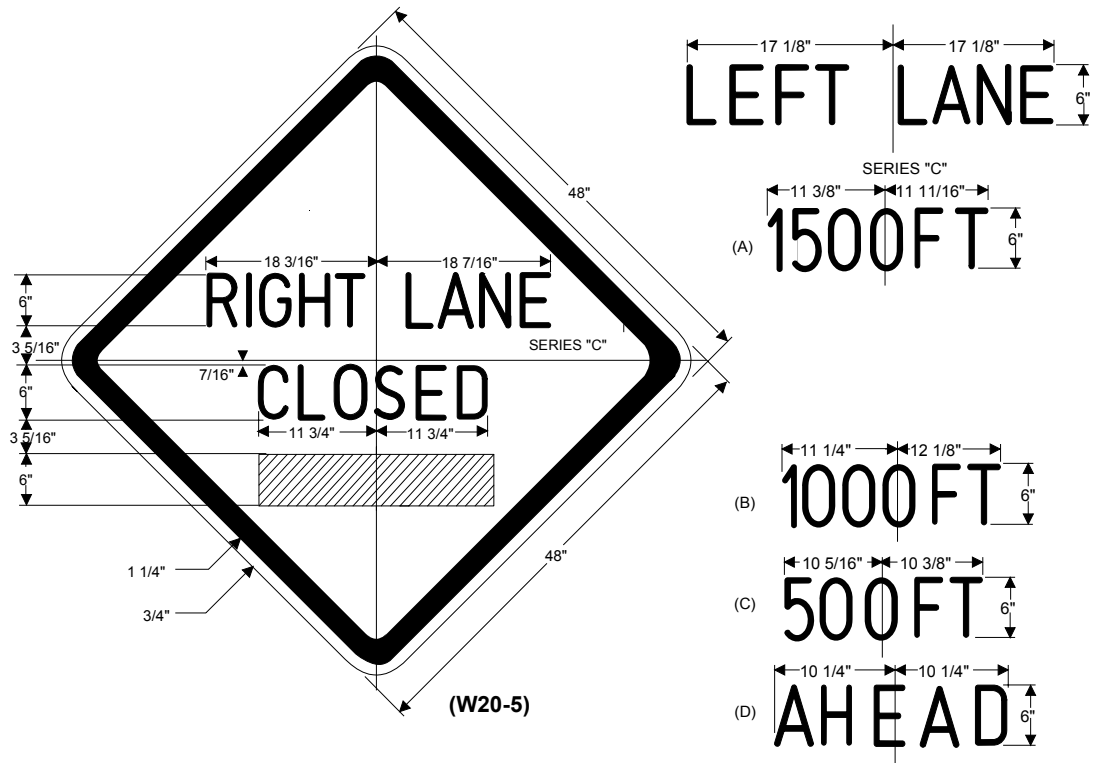
The advance merge sign shall be used in advance of a point where traffic must change lanes. It carries the legend Merge Right (or Left)_____.

B. Placement

It may be used in repetition with appropriate legends or in conjunction with other construction signs. Distances shall be adjusted to prevailing speed and traffic volume on the approaching roadway.

C. Size

It shall have a minimum size of (48) inches by (48) inches, except as provided for herein (Section B).



B-25 Advance Flagger Sign (W20-7)(-)

A. Justification

The advance flagger sign shall be used in advance of any point at which a flagger has been stationed to control traffic through a construction, maintenance or utility project. It carries the legend Flagger _____.

B. Placement

It shall be used in repetition with appropriate legends or in conjunction with other construction signs. Distances shall be adjusted to the prevailing speed and traffic volume on the approaching roadway.

The sign shall be promptly removed, covered, or turned to face away from the roadway whenever the flagger is not at his station.

C. Size

It shall have a minimum size of (48) inches by (48) inches, except as provided for herein.

B-26 The Two-Way Traffic Sign (W6-3)

A. Justification

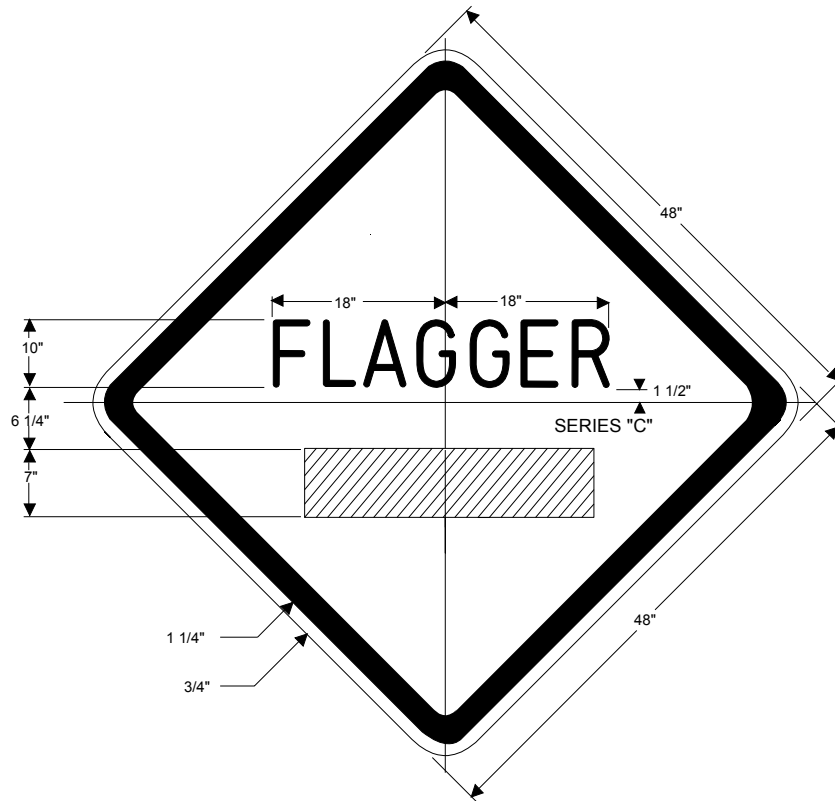
The two-way traffic sign shall be used at the beginning of two-way sections of normally divided highways and as needed at intervals to periodically remind drivers that they are on a two-way highway which contains opposing traffic. These signs shall not be used on normal two-way highways.

B. Placement

It may be used in repetition with appropriate legends or in conjunction with other construction signs. Spacing shall be adjusted to the prevailing speed and traffic volumes on the roadway.

C. Size

It shall have a minimum size of (48) inches by (48) inches and (24) inches by (18) inches except as provided for herein (Section B).



(A) 1500 FT

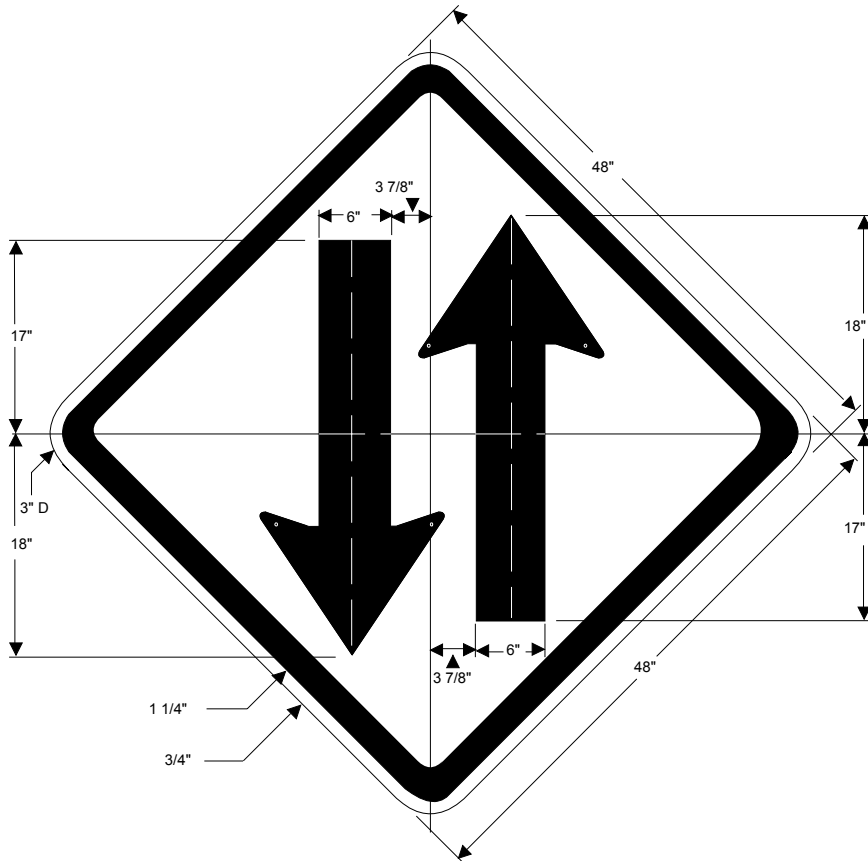
(B) 1000 FT

(C) 500 FT

(D) AHEAD

(W20-7)

COLOR: Black legend and border on an orange reflectorized background.



(W6-3)



B-27 Workers Sign (W21-1)

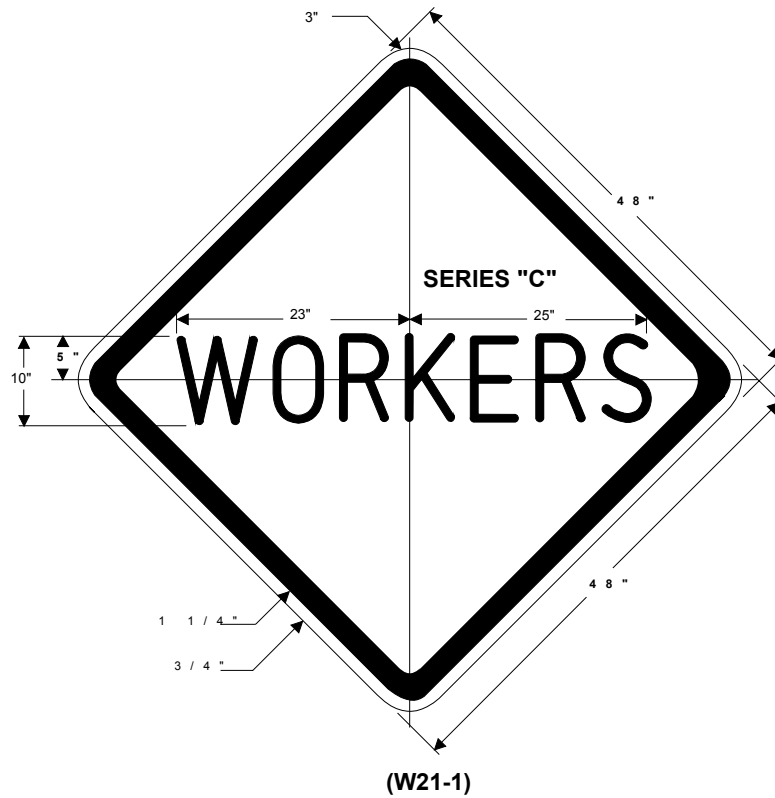
The Workers sign is intended for use in conjunction with minor maintenance and public utility operations for the protection of men working in or near the roadway. Workers signs will be used with other appropriate warning signs. On low-speed urban areas, the Workers sign is intended for use at limited obstruction sites which are adequately marked and clearly visible, such as an open manhole with a fence around it. It shall have a minimum size of (48) inches by (48) inches.

B-28 Fresh Oil Sign (W21-2)

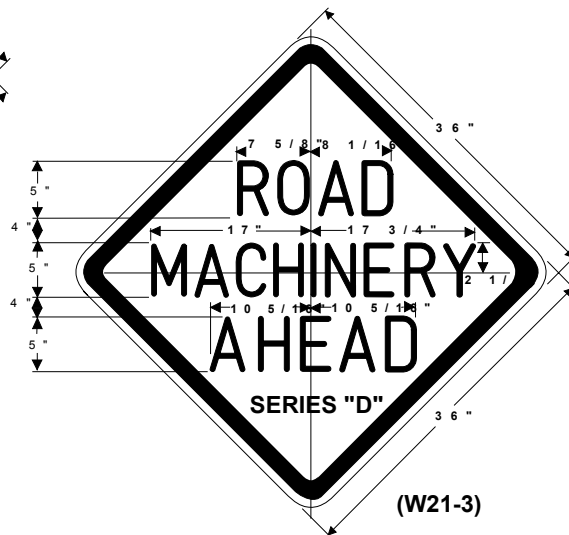
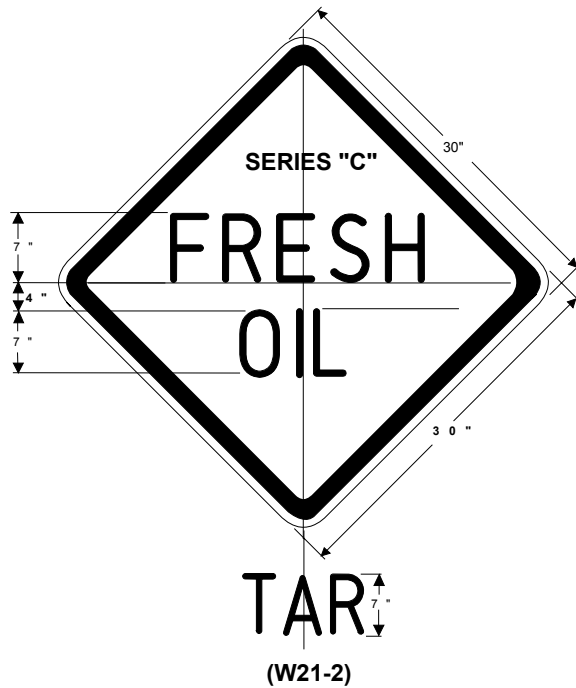
The Fresh Oil or (Fresh Tar) sign is intended for use to warn motorists that resurfacing operations have rendered the surface of the pavement temporarily hazardous and that objectionable splashing on vehicles may occur. It shall have a minimum size of (30) inches by (30) inches.

B-29 Road Machinery Sign (W21-3)

The Road Machinery sign is intended for use in areas where heavy equipment is operating in or closely adjacent to the roadway. It shall have a minimum size of (36) inches by (36) inches.



COLOR: Black legend and border on an orange reflectorized background.

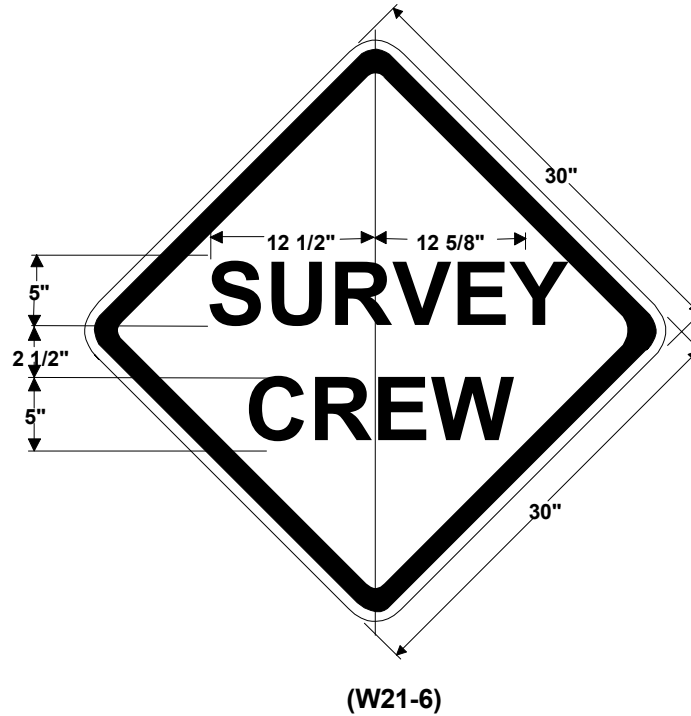
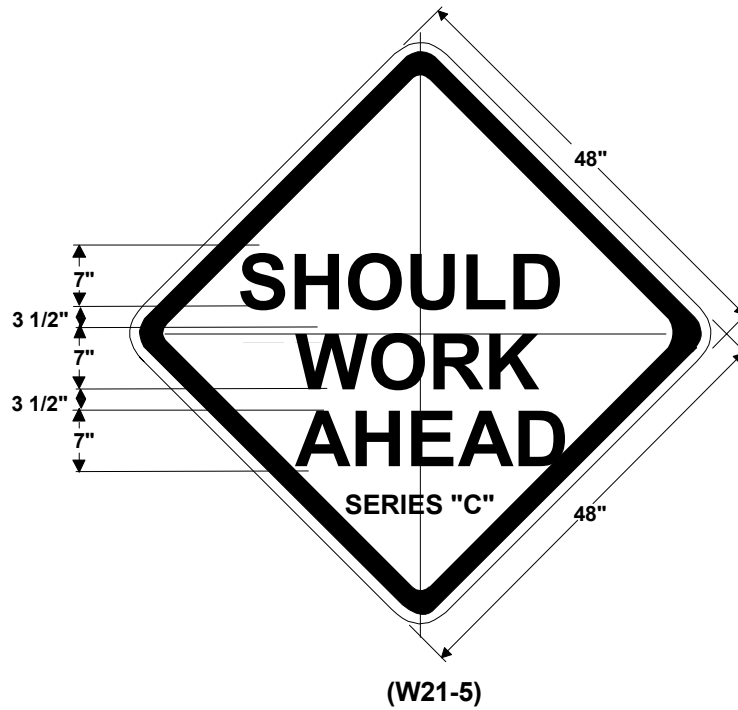


B-31 Shoulder Work Ahead Sign (W21-5)

The Shoulder Work sign is intended for use in advance of maintenance or minor reconstruction operations involving the shoulder, where the traveled way remains unobstructed. It shall have a minimum size of (48) inches by (48) inches.

B-32 Survey Crew Sign (W21-6)

The Survey Crew sign is intended for use in advance of a point where a surveying crew is working in or closely adjacent to the roadway. It shall have a minimum size of (30) inches by (30) inches.



COLOR: Black legend and border on an orange reflectorized background.

B-33 Signs for Blasting Areas

Recommended practices for application shall be obtained from the Chief Traffic Engineer.

B-34 Blasting Zone Sign (W22-1)

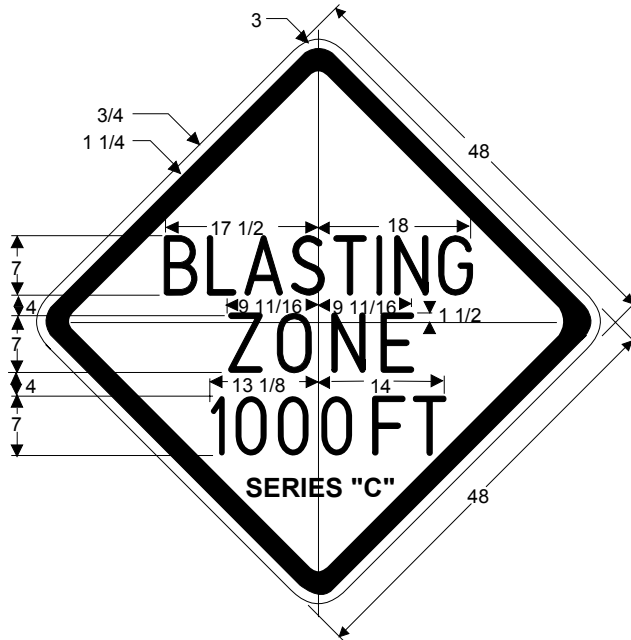
The Blasting Zone _____ ft. sign is intended for use in advance of any point or work site where there are explosives being used. The TURN OFF 2-WAY RADIO and END BLASTING ZONE signs must be used in sequence with this sign. Provision shall be made for covering or removing the sign sequence when there are no explosives in the area or the area otherwise secured.

B-35 Turn Off 2-Way Radios and Cellular Telephones Sign (W22-2)

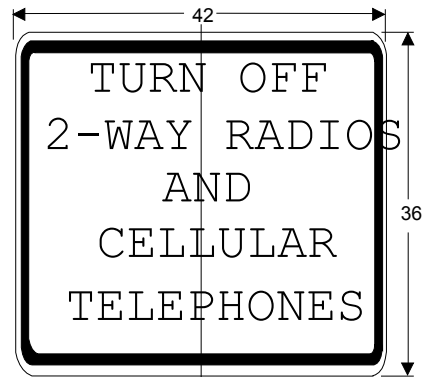
The Turn Off 2-Way Radios and Cellular Telephones sign is to be used in sequence with the BLASTING ZONE _____ FT. and END BLASTING ZONE sign and placed at least 1,000 feet from the beginning of the blasting zone. These signs shall be prominently displayed and covered or removed when there are no explosives in the area or the area otherwise secured.

B-36 End Blasting Zone Sign (W22-3)

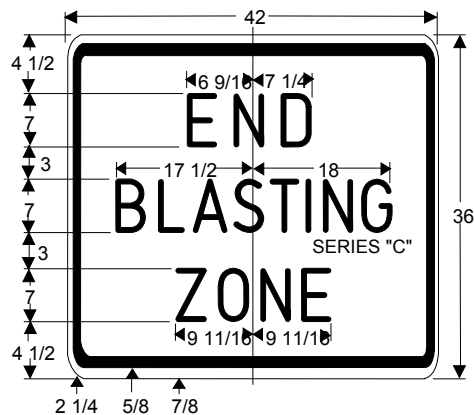
The End Blasting Zone sign is to be used to denote the end of the danger zone and shall be placed a minimum of 1,000 feet from the blasting zone, either with or preceding the END WORK sign.



COLOR: Black legend and border on an orange reflectorized background.
(W22-1)



COLOR: Black legend and border on an orange reflectorized background.
(W22-2)



COLOR: Black legend and border on an orange reflectorized background.
(W22-3)

B-37 Road Narrows Sign (W5-1)

A. Justification

This sign is intended for use in advance of a transition on two-lane roads where the pavement width is reduced abruptly to a width such that two cars cannot pass safely without reducing speed.

B. Placement

It shall be so placed that the driver will have adequate time for response.

C. Size

It shall have a minimum size of (36) inches by (36) inches.

B-38 Bump Sign (W8-1)

A. Justification

This sign is intended for use to give warning of a sharp rise in the profile of the road that is sufficiently abrupt to create a hazardous condition, to cause considerable discomfort to passengers, to cause a shifting of the cargo, or to deflect a vehicle from its true course at the posted speed limit for the road.

B. Placement

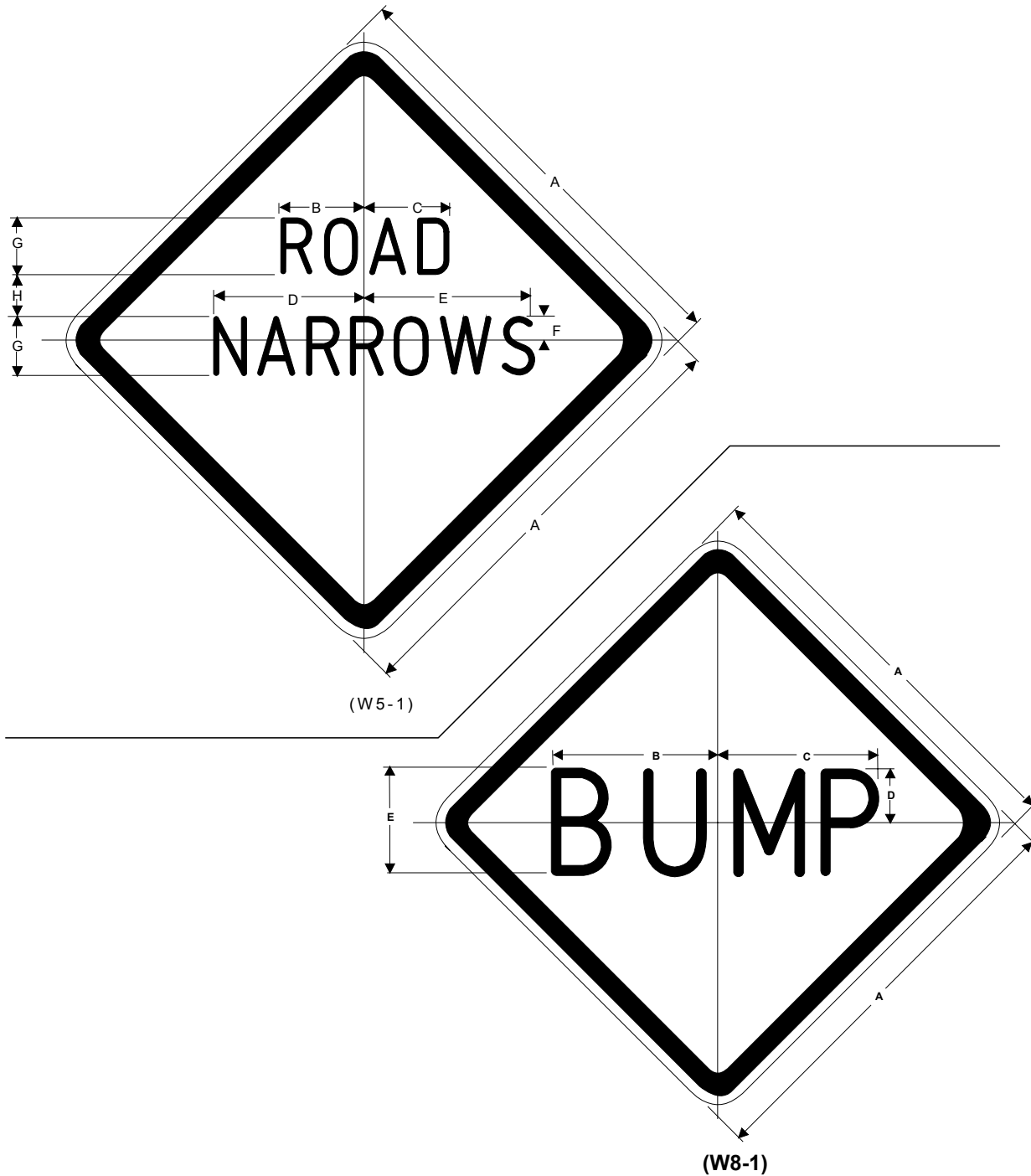
It shall be so placed that the driver will have adequate time for response.

C. Size

It shall have a minimum size of (30) inches by (30) inches.

SIGN SIZE	SERIES		MAR- GIN	BOR- DER	DIMENSIONS							
	LINES				A	B	C	D	E	F	G	H
36x36	D	D	1/2	3/4	36	7 3/4	8 1/2	14 3/8	14 11/16	1 3/4	5	3

COLOR: Black legend and border on an orange reflectorized background.



SIGN SIZE	SERIES	MAR- GIN	BOR- DER	DIMENSIONS				
	LINE			A	B	C	D	E
30x30	D	1/2	3/4	30	12 5/8	14 3/16	4	8

COLOR: Black legend and border on an orange reflectorized background.

B-39 Dip Sign (W8-2)

A. Justification

This sign is intended for use to give warning of a depression or drop in the profile of the road that is sufficiently abrupt to create a hazardous condition, to cause considerable discomfort to passengers, to cause a shifting of the cargo, or to deflect a vehicle from its true course at the posted speed limit for the road.

B. Placement

It shall be so placed that the driver will have adequate time for response.

C. Size

It shall have a minimum size of (30) inches by (30) inches.

B-40 Soft Shoulder Sign (W8-4)

A. Justification

The soft shoulder sign shall be used where a soft shoulder presents a hazard to vehicles that may get off the pavement. This sign is warranted on new shoulders and where shoulders are soft due to weather conditions.

B. Placement

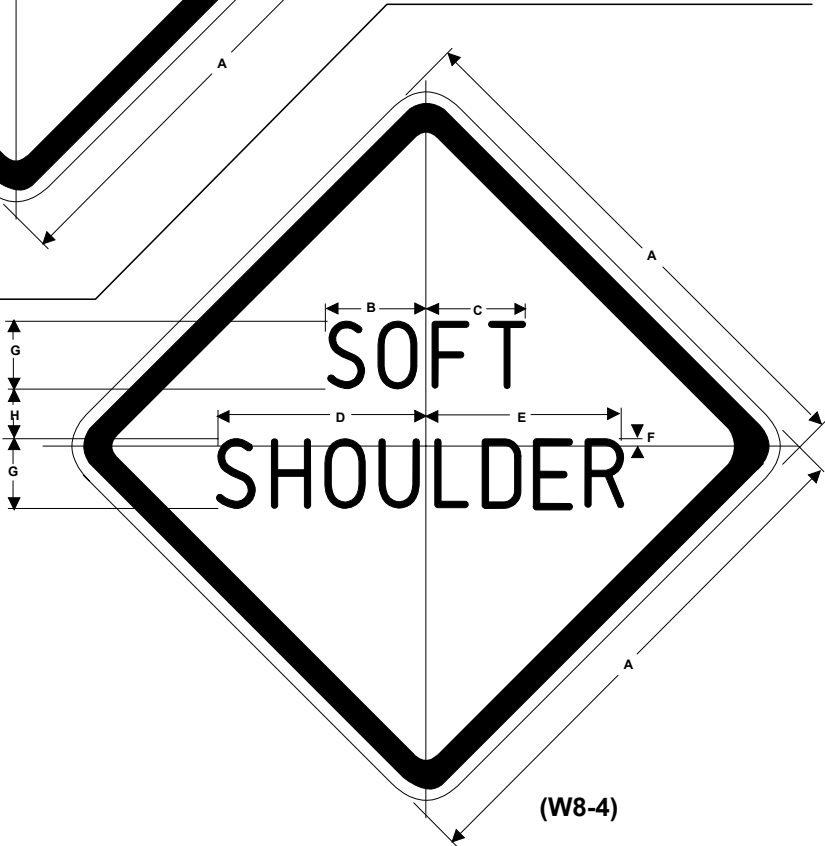
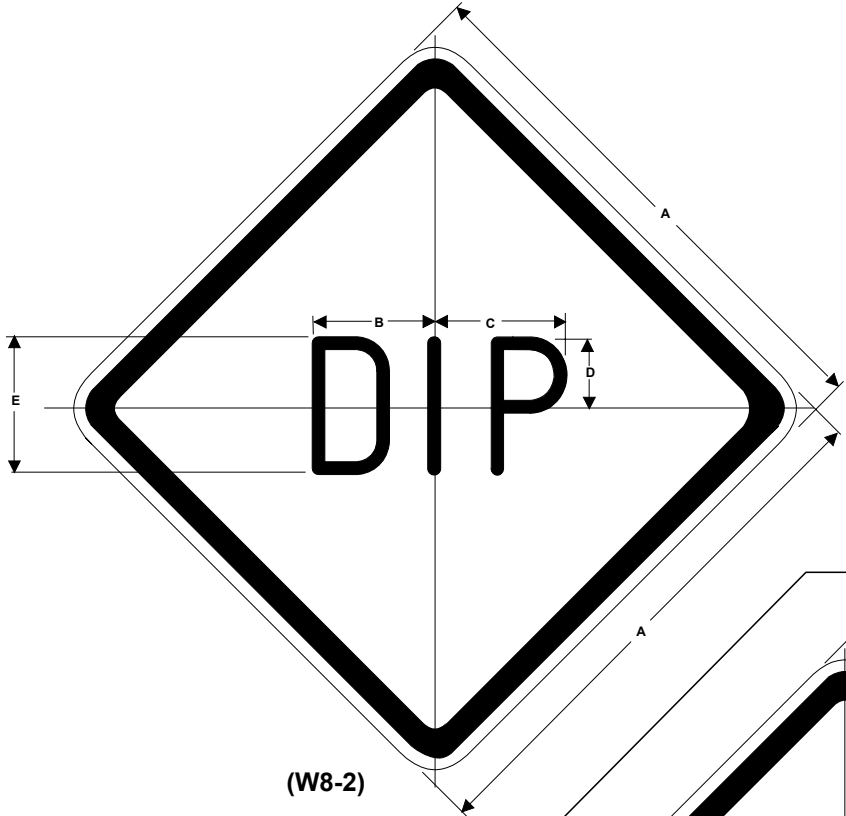
One sign shall be placed at or near the beginning of the soft shoulder condition, and other signs shall be placed at intervals throughout the length of the road where the condition exists.

C. Size

It shall have a minimum size of (30) inches by (30) inches.

COLOR: Black legend and border on an orange reflectorized background.

SIGN SIZE	SERIES	MAR- GIN	BOR- DER	DIMENSIONS				
	LINE			A	B	C	D	E
	1							
30x30	E	1/2	3/4	30	9 1/2	11	4	8



SIGN SIZE	SERIES		MAR- GIN	BOR- DER	DIMENSIONS							
	LINES				A	B	C	D	E	F	G	H
	1	2										
30x30	C	C	1/2	3/4	30	7	6 1/8	13 3/8	12 15/16	11/16	5	2 1/2

COLOR: Black legend and border on an orange reflectorized background.

B-41 Truck Crossing Sign (W11-1)

A. Justification

The truck crossing sign shall be used to warn motorists of hazardous crossings caused by heavy truck traffic in connection with construction, maintenance or utility operations.

B. Placement

Distance shall be adjusted to the prevailing speed and traffic volume on the approaching roadway.

C. Size

It shall have a minimum size of (30) inches by (30) inches.

B-42 Low Shoulder Sign (W8-4-1)

A. Justification

The Low Shoulder sign shall be used during resurfacing operations or whenever necessary to denote sections of the shoulder which are depressed for any reason from the pavement surface. It may also be used at any time that erosion, by any means, has caused the shoulder or adjacent material to become one(1) inch or more below the traveled portion of the roadway. (see page 52, vertical difference)

B. Placement

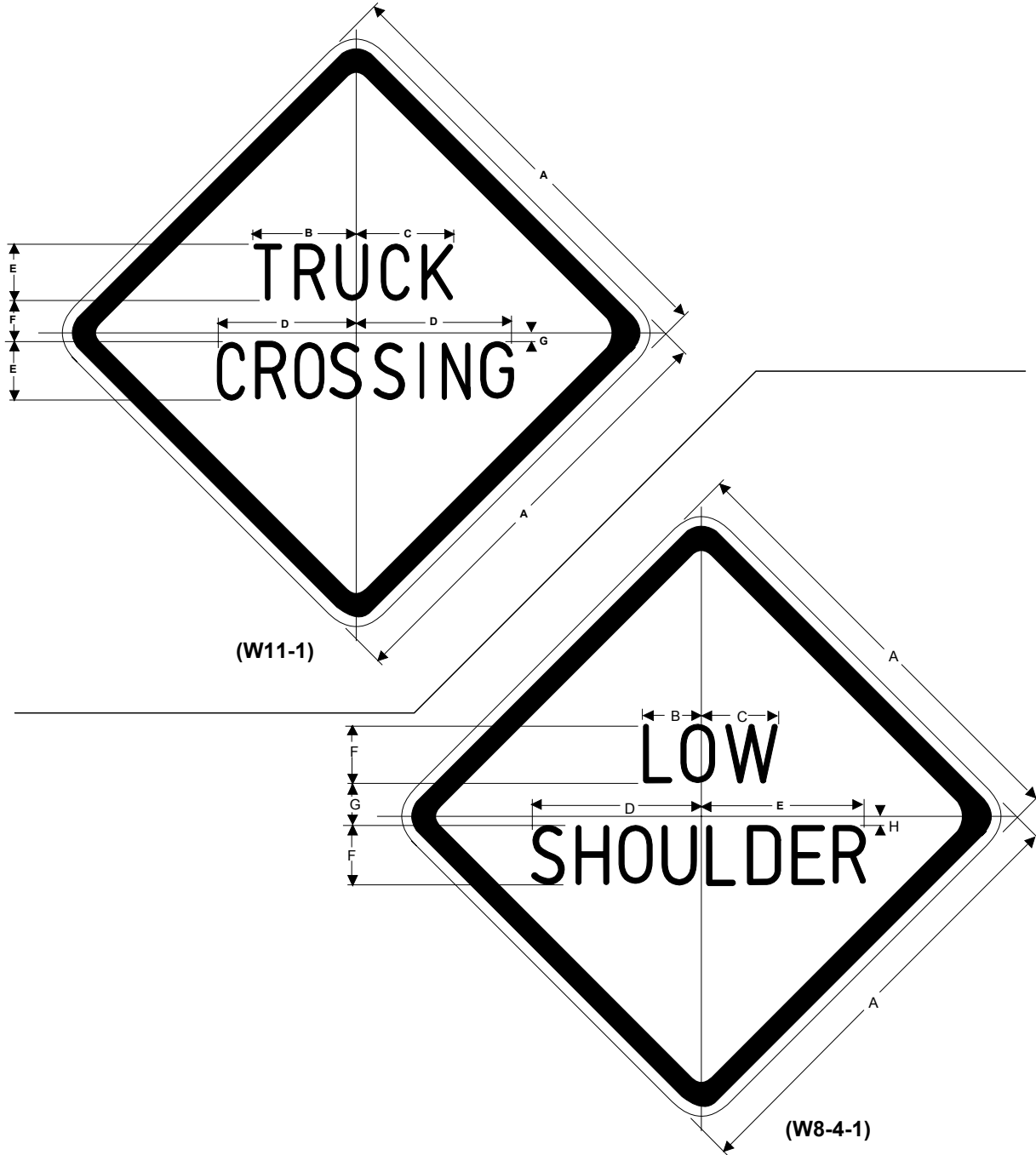
One sign shall be placed at or near the beginning of the low shoulder condition, and other signs shall be placed at intervals no greater than 2000 ft. throughout the length of the road where the condition exists. A minimum of two (2) signs shall be used.

C. Size

It shall have a minimum size of (30) inches by (30) inches.

COLOR: Black legend and border on an orange reflectorized background.

SIGN SIZE	SERIES LINES		MAR- GIN	BOR- DER	DIMENSIONS						
	1	2			A	B	C	D	E	F	G
30x30	C	C	1/2	3/4	30	8 1/2	8 7/16	12 1/2	5	3 1/4	3/4
48x48	C	C	3/4	1 1/4	48	13 5/8	13 5/8	20	8	5 3/16	5/8



SIGN SIZE	SERIES		MAR- GIN	BOR- DER	DIMENSIONS							
	LINES				A	B	C	D	E	F	G	H
	1	2										
30x30	C	C	1/2	3/4	30	5	5 1/2	13 5/16	12 15/16	5	3	5/8

COLOR: Black legend and border on an orange reflectorized background.

B-43 Uneven Pavement Joints Sign (W8-9) or (W8-9a)

A. Justification

The Uneven Pavement Joints sign shall be used whenever adjacent travel lanes present, to a motorist, a vertical difference as defined in C-8 page 52.

B. Placement

The Uneven Pavement Joints sign shall be placed prior to the condition to which attention is being directed over which the condition prevails. Whenever a motorist enters the work area from an intersecting road additional signs must be placed. A minimum of two (2) signs shall be used.

C. Size

It shall have a minimum size of thirty (30) inches by (30) inches with a black legend and border on an orange reflectorized background.

B-44 Advisory Speed Plate (W13-1)

A. Justification

The Advisory Speed Plate may be used in conjunction with a warning sign to indicate a maximum recommended safe speed through the hazardous area.

Except in emergencies, an advisory speed plate shall not be erected until the recommended speed has been determined by the Traffic Engineer.

B. Placement

When used in conjunction with a warning sign, it shall be mounted below the warning sign. It shall not be used in conjunction with any sign other than a warning sign, but it may be used alone to provide speed control that can be erected and removed by a contractor when the actual work area on a large project is concentrated or moves regularly.

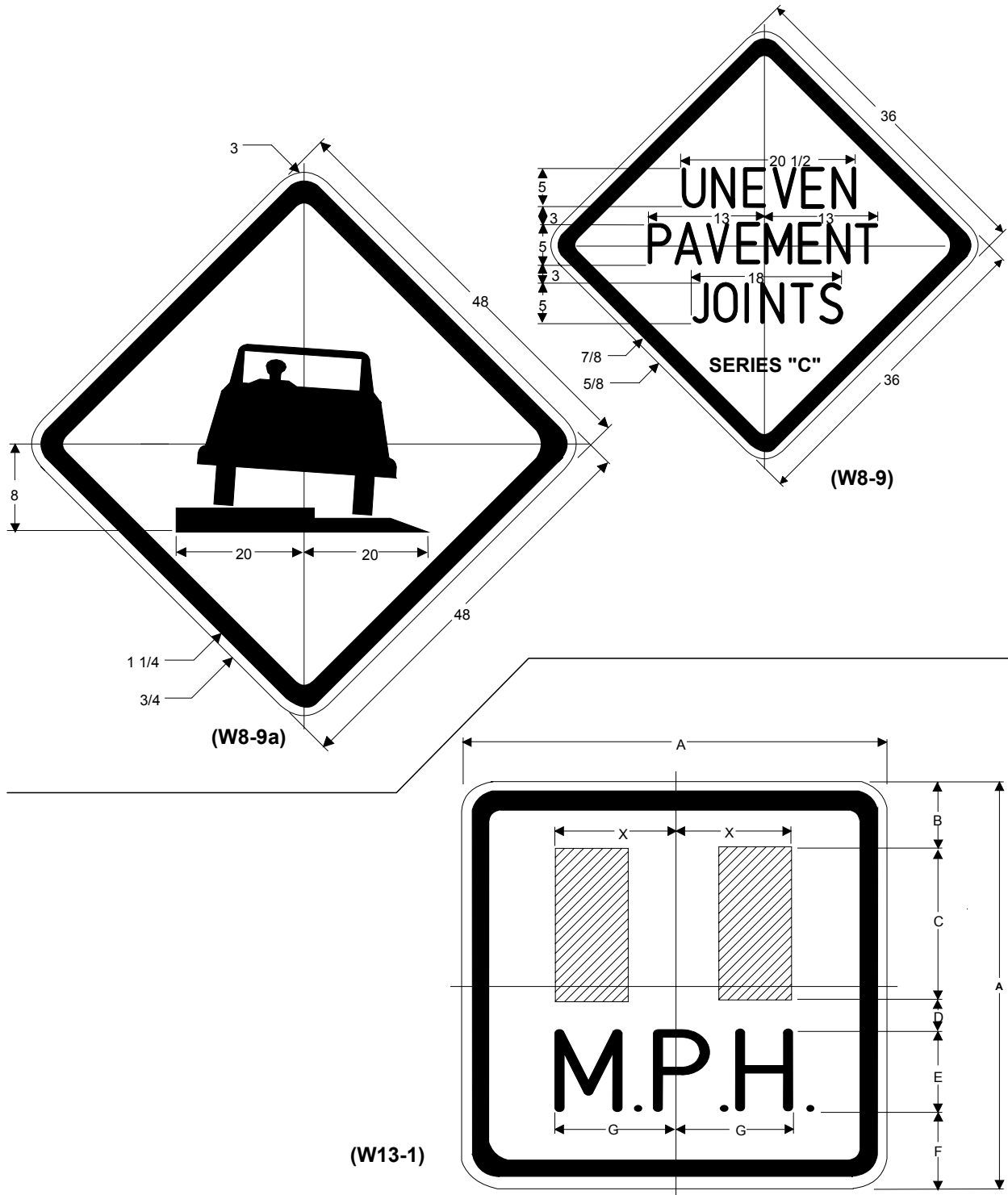
C. Size

It shall have a minimum size of (18) inches by (18) inches. The (18) inch by (18) inch size shall be used with a warning sign up to and including (36) inch signs. The (24) inch by (24) inch size shall be used with the (48) inch warning signs or when used alone.

B-45 Other Warning Signs

In addition to the warning signs specifically related to construction, maintenance or utility operations, there are numerous other warning signs, standardized for general use and treated in the Department's Manual on Uniform Traffic Control Devices, that may find application in work areas.

COLOR: Black legend and border on an orange reflectorized background.



SIGN SIZE	SERIES LINES		MAR-GIN	BOR-DER	DIMENSIONS								X					
	1	2			A	B	C	D	E	F	G	10	15	20	25	30	35	40
18x18	D	E	3/8	3/8	18	2 1/4	8	2	3	2 3/4	5 3/16	4 3/4	4 1/2	6 3/16	5 15/16	6 1/4	6 1/16	6 5/8
24x24	D	E	3/8	3/8	24	3 1/4	10	2 3/4	4	4	6 7/8	5 15/16	5 5/8	7 11/16	7 3/8	7 7/16	7 5/16	8 5/16

COLOR: Black legend and border on an orange reflectorized background.

GUIDE SIGNS

B-46 Function and Design of Information and Guide Signs

Informational signs required at construction, maintenance or utility sites include two categories:

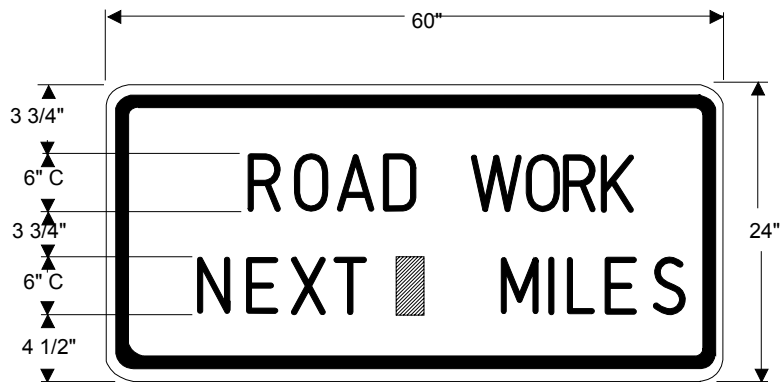
- A. Standard directional signs and route markings shall be used to the extent that temporary route changes are necessitated by road closing and detours.
- B. Special information signs relating to the work being done may be required and shall consist of a black message on a reflectorized orange background.

B-47 Length of Road Work Sign (G20-1)

- A. Justification: The length of road work sign shall be used at the limits of any road construction or maintenance job of more than two (2) miles in extent, where traffic is maintained through the job site. This sign will be used where required for jobs of lesser length on urban streets with appropriate distances shown.
- B. Placement: It shall be erected at the beginning of the job site and may be effectively mounted on a wing barricade.
- C. Size: It shall have a minimum size of (72) inches by (48) inches.
- D. Mileage: It shall be to nearest whole mile - no fractions of miles i.e. 3 miles; 5 miles, etc.

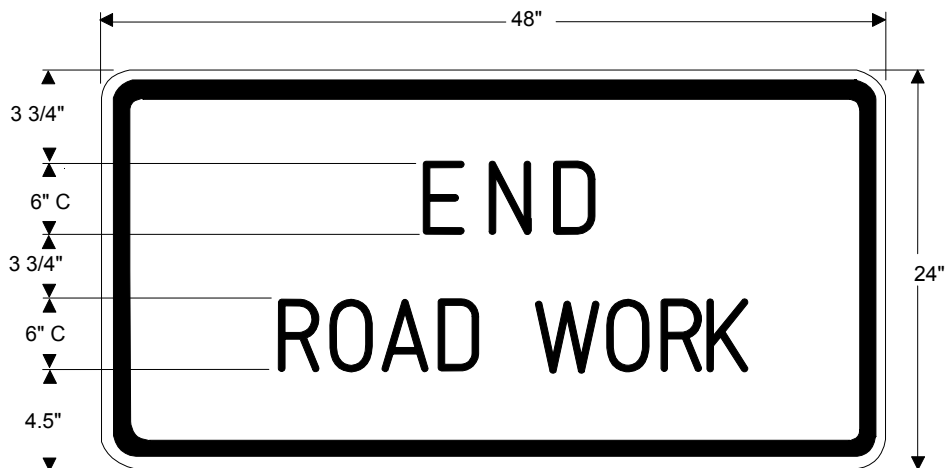
B-48 End Road Work Sign (G20-2)

- A. Justification: The End Road Work sign shall be used at the limits of a construction or maintenance job, where traffic is maintained through the job site.
- B. Placement: It shall be erected approximately 500 feet beyond the end of the job site. (10 AUG 90 - REV 1)
- C. Size: It shall have a minimum size of (48) inches by (24) inches.



(G20-1)

COLOR: Black legend and border on an orange reflectorized background.



(G20-2A)

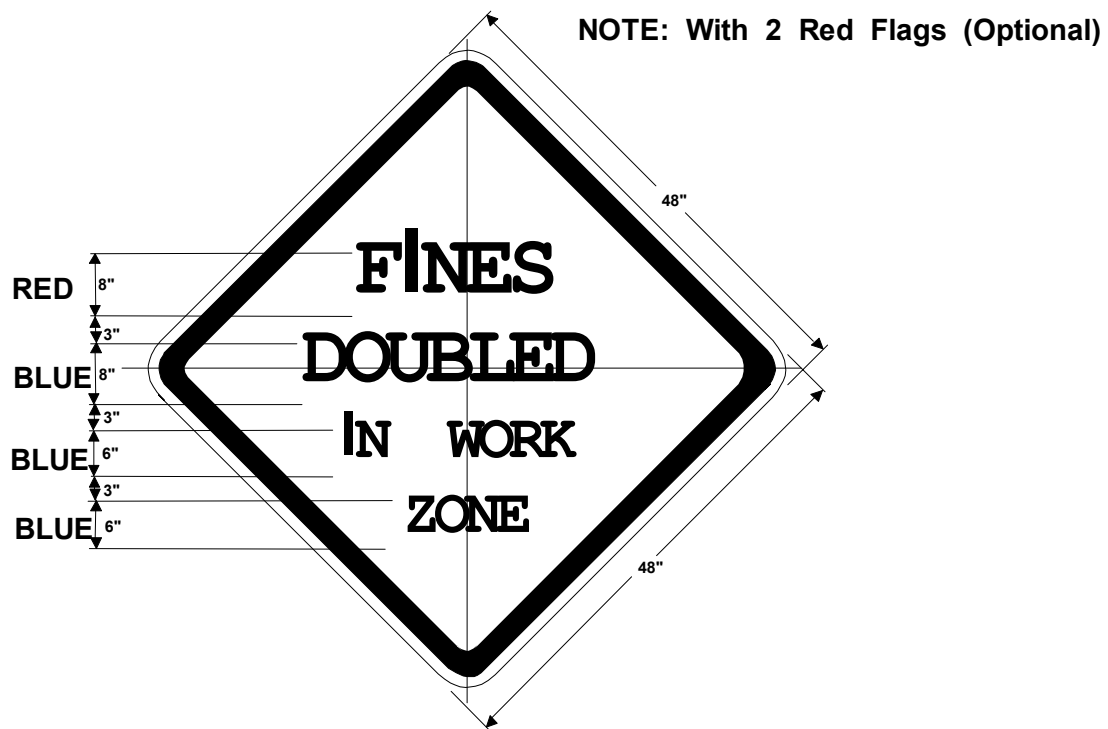
COLOR: Black legend and border on an orange reflectorized background.

B-49 FINES DOUBLED IN WORK ZONE

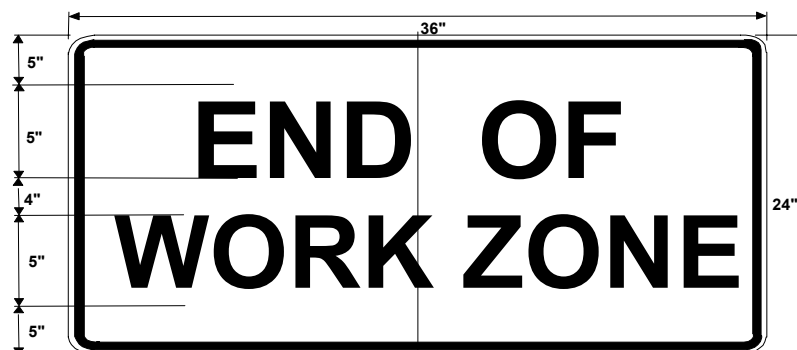
Delaware Law provides for traffic violation fines to be doubled in utility, construction, and maintenance work zones. To aid in warning the motorist the "Fines Doubled in Work Zone" signs have been developed. These signs shall be used for work zones on high speed roadways. The signs may be used on other work sites as specified in plans.

- A. Justification The "FINES DOUBLED IN WORK ZONE" sign will help to ensure the safety of road, and utility, construction and maintenance personnel, as well as that of the public traveling through areas of utility, construction and maintenance work.
- B. Placement "FINES DOUBLED IN WORK ZONE" sign should be placed between 1500' feet and 1000' feet advanced warning sign

"END WORK ZONE" should be placed under the "END OF ROAD WORK" sign.



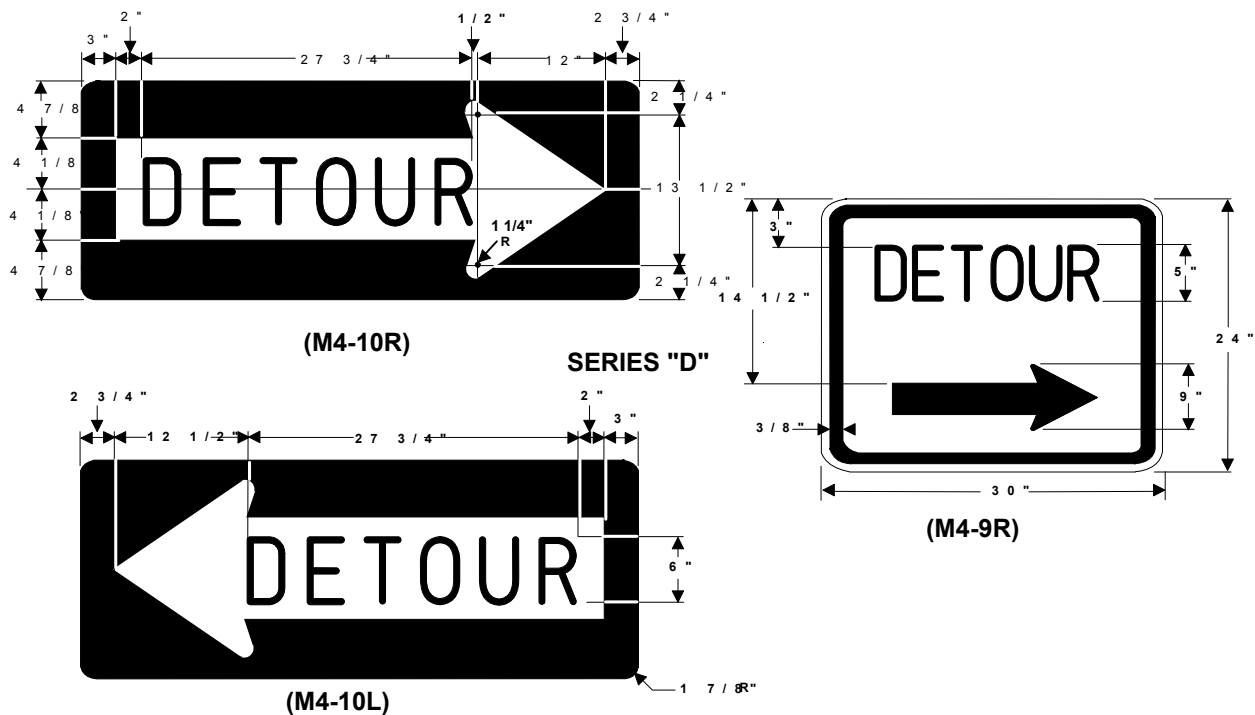
COLOR: Blue border on an white reflectorized background,
FINES in red, and DOUBLED IN WORK ZONE in blue.



COLOR: Blue Legend and Border on White Reflectorized Background.

B-50 Detour Arrow Sign (M4-10), Detour Sign (M4-9)

- A. Justification: The Detour Arrow Sign (M4-10) is used when a detour roadway or route has been established due to the closure of a street or highway to through traffic.
- B. Placement: It is erected at the point of closure to through traffic. It is mounted just below the Road Closed Sign (Sec. B-8) or the Local Traffic Only Sign (Sec. B-9). The Detour Arrow Sign shall be used as a horizontal arrow point to the right or left as required at each location.
Each detour may be marked with standard temporary route markers and destination signs, as a responsibility of the Division of Highways. If an unmarked street or highway is detoured, the Detour Sign (M4-9) may be used to indicate the points at which the detour changes direction.
- C. Size: M4-9 shall have a minimum size of (30) inches by (24) inches. M4-10 shall have a minimum size of (18) inches by (18) inches.



COLOR: ReflectORIZED orange arrow with black letters and background.

C - BARRICADES, CONES, ETC.

C-1 Barricades

The only barricades permitted for use on all roads, streets, and highways is the type III.

NOTE: All Width Dimensions Are Standard Lumber Sizes. Number of Reflectorized, Rails
4-(two each direction)

C-2 Characteristics

Width of Rail	8"min.	12"max.
Length of Rail	4'min.(per MUTCD)	variable max.
Width of Stripes	6 in.	
Height	5'min.	8'max.
Minimum Height of Bottom Rail From Ground	18"	
Minimum Distance	N/C	
Between Rails	8"	
Type of Frame	Post or Skids	
Flexibility	Essentially Permanent	

C-3 Markings

Barricade Design and Application

Barricades with stripes that begin at the upper right side and slope downward to the lower left side are to be designated as "right" (R) barricades. Barricades with stripes that begin at the upper left side and slope downward to the lower right side are to be designated as "left" (L) barricades.

Markings for barricade rails shall be alternate orange and white stripes (sloping downward at an angle of 45 degrees in the direction traffic is to pass.)

Where a barricade extends entirely across a roadway, it is desirable that the strips slope downward in the direction toward which traffic must turn in detouring. Where both right and left turns are provided for, the chevron striping may slope downward in both directions from the center of the barricade.

Barricade rails should be supported in a manner that will allow them to be seen by the motorist and provide a stable support not easily blown over by the wind or traffic.

NOTE Type I and Type II barricades shall not be used on all roads, streets, and highways

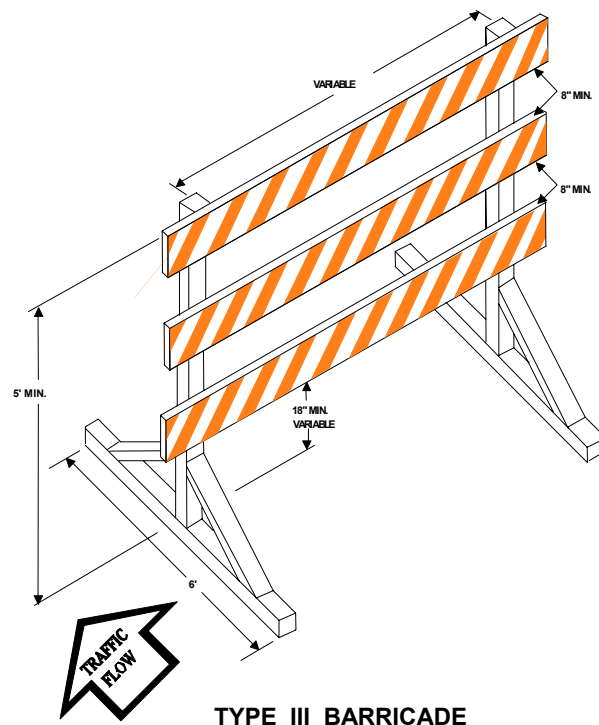
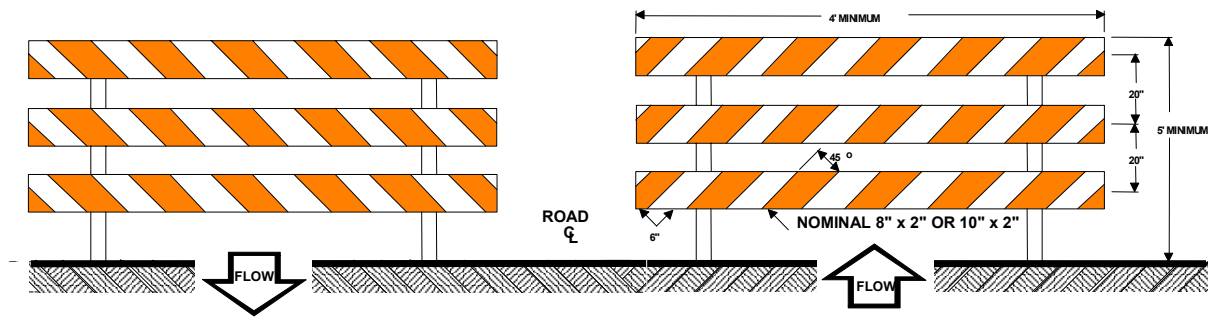
C-4 Barricade Construction

Since Type III barricades are somewhat permanent in nature and are required to function in one location for a relatively long time, they should be substantially constructed. When the barricades are constructed on bases instead of posts set into the ground, it may be desirable to ballast the bases with sandbags to provide added resistance to overturning during periods of high winds.

C-5 Barricades and Channelizing Devices

The function of barricades and channelizing devices are to warn and alert drivers of construction, maintenance, and utility activities in or near the traveled way, and to guide and direct drivers while providing maximum safety for the equipment and the workers on the job.

Barricades and channelizing devices are elements in a total system of traffic control devices for use in highway construction, maintenance and utility operations, and these elements shall be preceded by a system of warning devices that are adequate in size, number, and placement for the type of highway on which the work is to take place.



* The intent of this diagram is to show the correct position of approaching or passing traffic relative to the diagonal striping of the device. All Type III Barricades must meet the specifications of NCHRP 350.

C-6 Vertical Difference

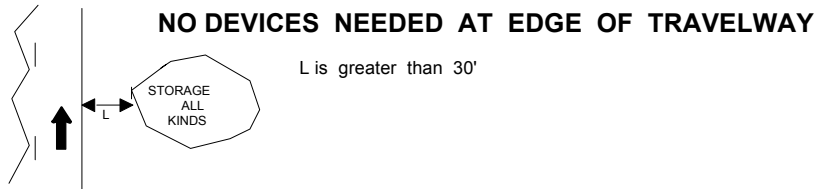
A Vertical Difference is created whenever a difference in grade of more than one (1) inch exists:

1. Between the travelway and an adjacent area.
2. Across a travelway.
3. Along or between a travelway(s).

Examples of causes include, but are not limited to, milling or excavation for paving, repaving lifts, and utility operations.

- A. Operations shall be sequenced so vertical differences of greater than three (3) inches do not exist across a travelway open to traffic or between adjacent travelways open to traffic.
- B. Whenever a vertical difference of more than one (1) inch exists on or within 10 feet of a travelway, warning signs must be displayed.
 1. For differences along or between travelways, the sign is "Uneven Pavement Joints" (Section B-43), or Symbol Sign.
 2. For differences between travelway and a shoulder or at edge of pavement less than 10' from travelway, the sign is "Low Shoulder" (Section B-42).
 3. For transverse differences within a travelway, the sign "Bump" (Section B-38) or "Dip" (Section B-39) shall be used.
- C. Whenever a vertical difference of one (1) inch to six (6) inches exists on or within 10 feet of a travelway, the following requirements shall be met:
 1. In addition to the Warning signs required above, drums, cones, or vertical panels shall be used at the edge of the travelway.
 2. The work area is limited to distances of not more than 1,000 feet. Traffic shall be under flagger control or under portable traffic signal control.
 3. Transverse vertical differences across the travelway and shoulder shall be ramped with Bituminous TRM material at a slope of 20 to 1 or flatter.
 4. Vertical differences between travelways up to 2 inches require no Awedge@ provided the difference is eliminated no later than the following day.
 5. Adjacent to travelways, at the end of the work day, a fillet of material, a "wedge" of gravel, or other suitable material as directed by the Engineer shall be placed in a manner that will provide stability for errant vehicles. This material must be placed no steeper than a 4 to 1 slope. Drums and warning signs with lights are required. See Case in Manual for details.

STORAGE OF EQUIPMENT



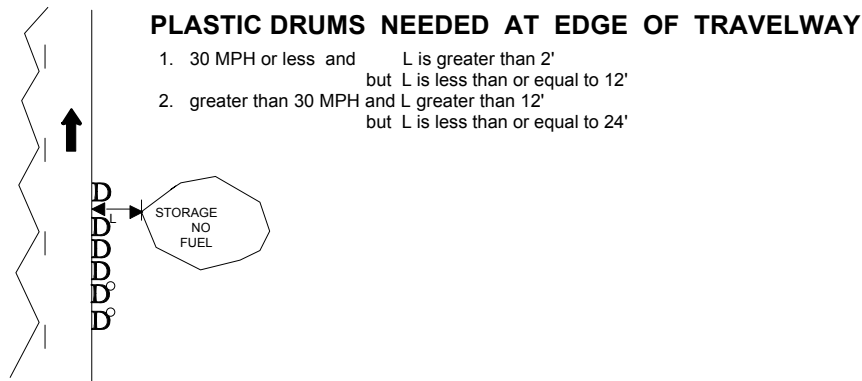
SYMBOLS

D Drums

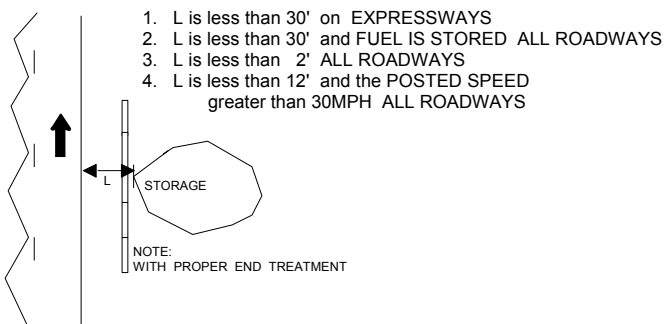
L Variable Distance in feet

LIGHT SYMBOLS

○ Type "B" amber high-intensity light



BARRIER NEEDED



- D. Whenever the vertical difference is greater than six (6) inches and less than 10 feet from travelway, the following steps must be followed:
1. In addition to the Warning signs required above, drums, cones, or vertical panels shall be used at the edge of the travelway.
 2. The work area is limited to distances of not more than 1,000 feet. Traffic shall be under flagger control or under portable traffic signal control.
 3. If the vertical difference is in the travelway, it shall be plated or backfilled at the end of the work day.
- E. If the vertical difference can not be properly reduced to less than six (6) inches during non-working periods, portable barriers are required. This applies to trenches, excavations, holes, or pavement lifts greater than 6" within 30' from the travelway unless directed by the Engineer. If the vertical difference is properly reduced to less than six (6) inches during non-working periods, Paragraph C. above applies during those periods.
- F. Whenever a vertical difference of one (1) to three (3) inches exist on an obstacle (manhole, water valve, catch basin, junction well, etc.) in a travelway open to traffic, a "wedge" of Bituminous TRM shall be placed in a manner that provides a ramp with a slope no steeper than 20 to 1.

C-7 Storage of Equipment and Materials

Storage occurs whenever materials or equipment are placed less than thirty (30) feet from a travelway. Each Storage area shall be treated as a road side obstacle.

Examples of storage include, but are not limited to pipe, sand, gravel, fuel, propane, burning equipment, cranes, graders, and rollers.

The traffic control devices noted herein shall be provided to define and protect each Storage area.

- A. Warning signs shall be placed for each Storage area as directed by the Engineer.
- B. Portable barriers shall be placed for any Storage:
1. On Expressway, Freeway, and limited access facilities.
 2. Within two feet of the edge of any travelway.
 3. Of fuel, propane, or other flammable materials within thirty (30) feet of the travelway.
 4. That is less than twelve (12) feet from the travelway where the posted speed is greater than 30 M.P.H.
- C. If the posted speed is 30 M.P.H. or less and portable barriers are not required, plastic drums shall be placed at the edge of the travelway.
- D. If the storage is twelve (12) feet but less than 24 feet from the travelway and the posted speed is greater than 30 M.P.H., plastic drums are required.
(see previous page for appropriate details)

C-8 Traffic Cones

Traffic cones shall be a minimum of 28 inches in height with a broadened base and made of materials which will withstand impact without damage to themselves or to vehicles.

18 inch cones may be used for pavement markings operations.

Orange shall be the predominant color on cones when viewed in either daytime or artificial light. They shall be kept clean and bright for maximum target value.

Cones must have reflective white collars for nighttime use. A 6 inch white reflective bands must be 3 to 4 inches below the top of the cone. An additional 4 inch white reflective band placed 2 inches below the 6 inch white band.

C-9 Flexible Guide Markers

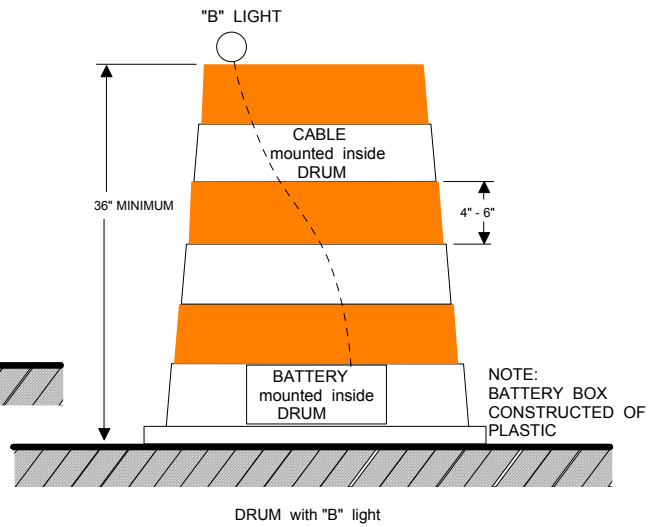
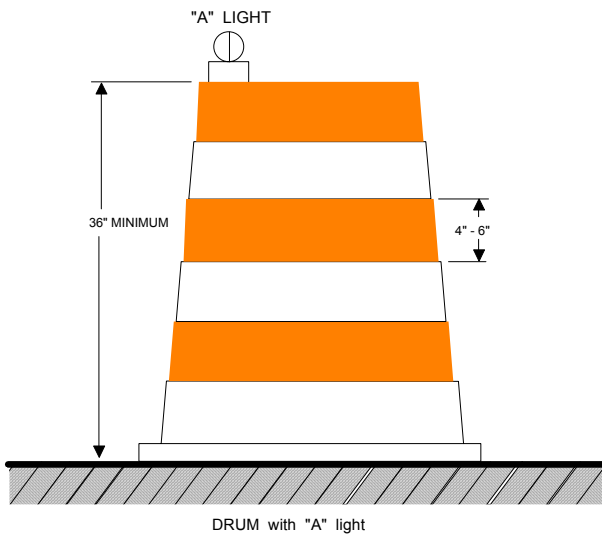
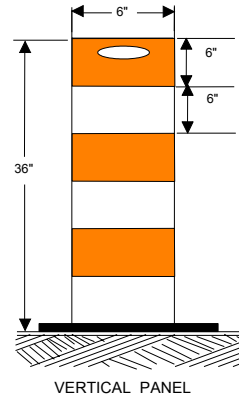
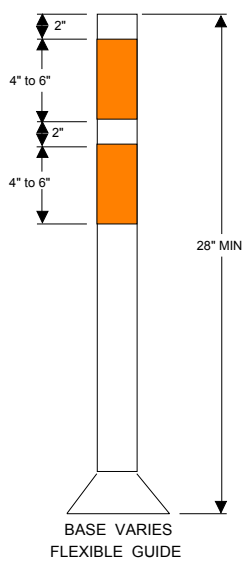
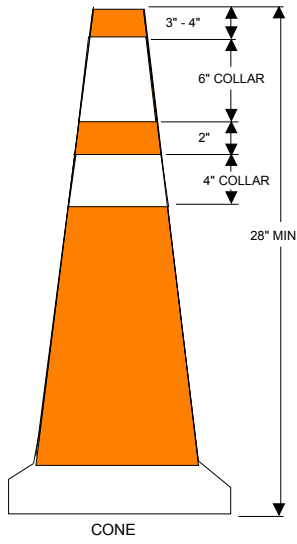
Flexible guide markers shall be constructed of not less than 2.125 inches outside diameter tubular material, and shall be designed to withstand impact without damage to themselves or to vehicles and to return to an upright position after impact. They shall be a minimum of 28 inches in height. The basic flexible guide markers shall be orange in color. Reflectorization shall be added to the uppermost twelve (12) to sixteen (16) inches of the flexible guide marker. There shall be minimum of two(2) bands with four(4) to six(6) inches of orange reflective material or other color as specified on the approved Traffic Control Plan. The standards for reflective material shall be not less than the standards prescribed for advance warning signs used for construction, maintenance and utility activities.

The spacing for flexible guide markers shall be not more than 25 feet on curves and not more than 50 feet on tangent sections of a travelway.

The supporting base of the flexible guide marker shall be firmly attached to the road surface per manufacturers specifications.

C-10 Vertical Panels

Vertical panels used as channelizing or warning devices shall be a minimum of 12 inches in width and a minimum of 36 inches in height. They shall be Orange and White Striped and Reflectorized (see diagram for details). If used for traffic in two directions, they shall be reflectorized on both front and back. These devices may be used for traffic separation or shoulder barricading where space is at a minimum, in lieu of a drum provided approval is obtained from the Engineer.



C-11 Plastic Drums

Construction, Maintenance or Utility Projects.

Drums shall not be less than 3 feet high or not less than 18 inches in diameter perpendicular to the travel lane, and not less than 14 inches in any diameter. The predominant color of drums shall be orange with at least 2 orange and 2 white reflectorized stripes, 4 to 6 inches wide. The markings on drums shall be horizontal and circumferential. Narrow gaps between stripes are permitted.

The drum shall be 2 pieces. It must be capable of being securely fastened together in such a manner as to prevent accidental separation from air turbulence, created by passing trucks and normal winds.

The drum when impacted shall separate from its base section and ballast weight. The base shall be low enough to allow an automobile to pass over it without making contact with the vehicle undercarriage.

Type "A" warning light and mounting bracket shall be capable of withstanding an impact without becoming detached from drum.

Drums are an effective traffic control device for use in delineating an unusual vehicle path. Another effective application occurs on road widening projects where a row of drums is used at night to mark the edge of the pavement. During working hours the same drums are moved onto the pavement to provide working room for the construction activity and smoothly channelize traffic around the work area. Drums may also be used singly or in groups to mark specific hazards, with the appropriate lights. Drums are highly visible and have good target value. They give the appearance of being formidable obstacles and, therefore, command the respect of drivers, yet they do not inflict undue damage to a vehicle in the event of being struck. Drums shall not be weighted with sand, water, or any material to the extent that would make them hazardous to motorists. Weights shall never be placed on top of drums.

When using a Type "B" warning light, the battery shall not be mounted on top of the plastic drum.

Drums must be upright and attached to the weighted base when on a job site except for those contained within a defined storage area.

C-12 Portable Barrier

Portable Barrier's are usually made of concrete. They are designed to contain and redirect an errant vehicle. Portable barriers may be precast sections with built in connecting devices.

Channelization of traffic through a work area may be accomplished by the use of a portable barrier. This device may be used for traffic separation or shoulder barricading.

When the barrier is used in a lane or shoulder closing situation, the barrier should be preceded with channelizing devices placed along a standard lane or shoulder closing taper.

- A. Installation should be designed so that expected contacts will occur at angles of approximately ten degrees or less. The maximum upper limit is fifteen degrees.
- B. Offsets of three feet are desirable where possible. Offsets of one foot in ten foot lanes are a minimum.
- C. The devices are to be linked together continuously for a minimum of one hundred (100) feet in any one installation.
- D. Protection of the lead end of the barrier by attenuating devices is required at all times except under the following conditions:
 - (1) lead end is located 30 feet from travel lane.
 - (2) lead end turns into a bank or hill.
 - (3) lead end turns into guardrail and the guardrail is anchored to the face of the portable barrier in a manner that will minimize formation of a pocket when struck in an accident.
- E. MAINTENANCE OF PORTABLE BARRIER
 - (1) To be painted white on traffic side before installation unless directed by the Engineer.
 - (2) To be painted white every March, July, and November unless directed by the Engineer
 - (3) White surface to be cleaned once a month while construction is active unless directed by the Engineer. Cleaning in winter months must be done so as not to create ice on the roadway.
- F. If the lead end is protected by an attenuating device, there shall be two (2) Type "B" amber flashing lights mounted horizontally at least two (2) feet apart on the lead end of the actual barrier. Batteries for the Type "B" light shall be mounted on top of the barrier or shall be located on the work zone side of the barrier. The first reflective panel shall be mounted within ten (10) feet of the Type "B" lights.

- G. Under conditions where attenuating devices are not required to protect the lead end, the first non-directional reflective panel shall be mounted on the first element of the barrier or on a taper when the taper reaches a point which is less than 15 feet from the travelway, reflective panels shall be used on curb barrier at fifty (50) feet intervals on non-tangent sections and at one hundred (100) foot intervals on tangent sections. At least six(6) reflective panels shall be used in every case.
- H. The device shall be installed with traffic starting at the lead end of the taper. It shall be removed against traffic.
- I. Lights and reflective devices shall be installed as the individual sections are installed.
- J. Sections of the barrier stored within thirty feet of a moving lane of traffic shall be protected in accordance with the above requirements.
- K. Portable barrier shall be used whenever:
 - (1) A vehicle entering, in, or leaving a work area would be subjected to extreme hazard.
 - (2) A vehicle out of control would hit any of the following:
 - a. Material or equipment stored within 12 feet of the near edge of an open travelway.
 - b. Fuel or chemical storage containers.
 - (3) Traffic on an otherwise divided highway is placed on an undivided travelway which has fewer travel lanes than the divided area.
 - a. On either end of the work area.
 - b. Prior to start of the work area.
- L. The appropriate color edge line is always required when using Portable Barriers.

C-13 Portable Barrier 6' Curve Section

Placement:

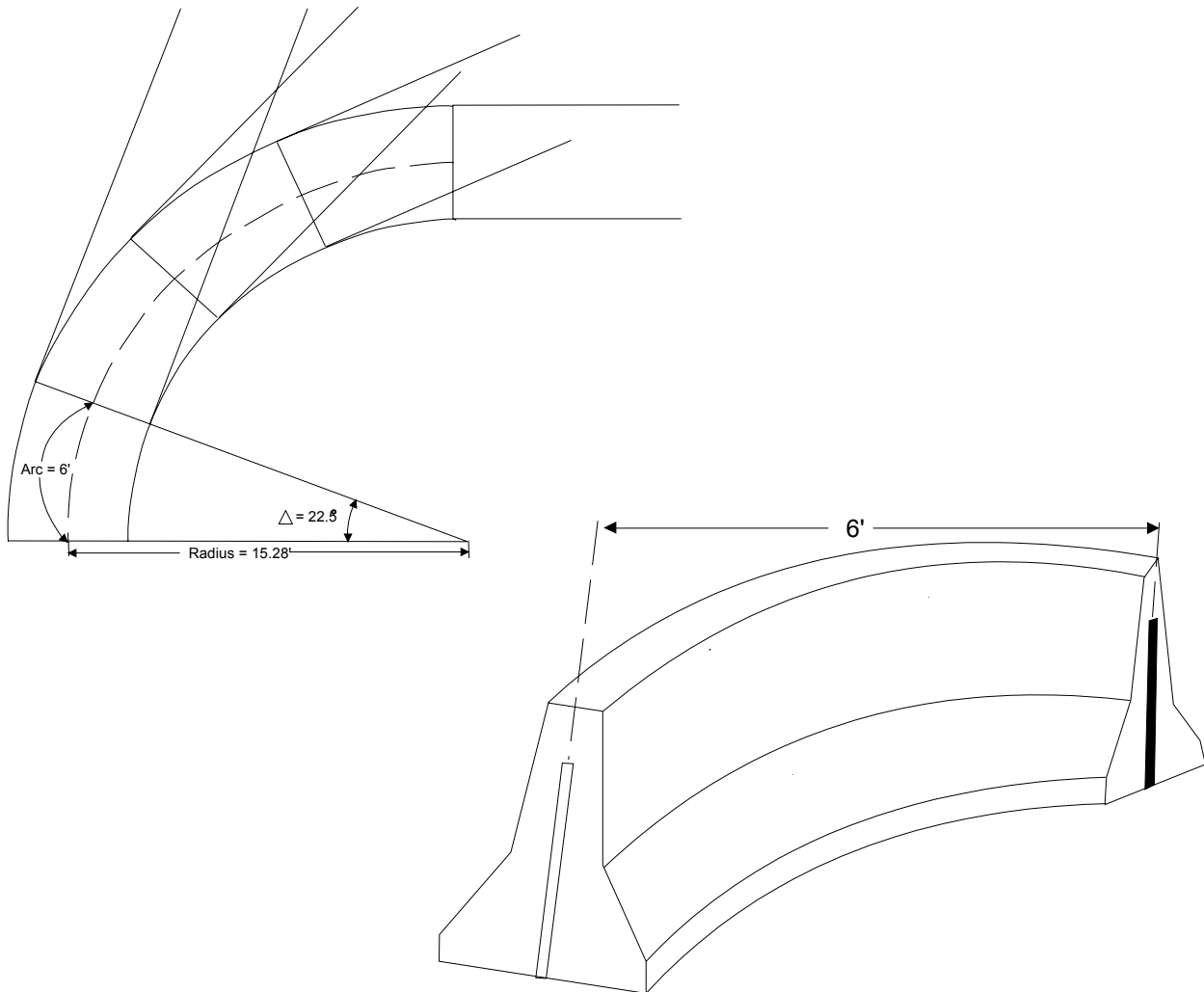
The portable barrier 6' curve section is placed on curve sections of concrete barriers, to eliminate a pocket or pinch point where an auto could snag. Portable barrier 6' curve section shall be linked together with steel plate insert.

*Application:

Portable concrete curb radius barriers may be used where the posted speed is 35 MPH or less, to provide a positive and smooth connection between tangent and flared sections of portable concrete barrier into a shopping center or driveway.

If the portable concrete radius barrier is used at any intersection or where the posted speed is greater than 35 MPH, the design must be approved by the Traffic Engineer.

The device shall be painted white on the traffic side.



C-14 Portable Concrete Barrier End Protection

Traffic shall be protected from exposed portable concrete barrier. Crash cushion impact attenuators and tapered end sections are used to protect vehicles from impacting blunt ends of portable concrete barriers.

End protection is required if the blunt end is less than thirty (30) feet from the travelway with the posted speed greater than 35 m.p.h. An impact attenuator or crash cushion shall be installed.

If the blunt end is less than thirty (30) feet from the travelway with the posted speed of 35 m.p.h. or less, a tapered end section shall be installed.

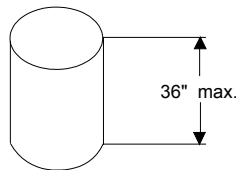
NOTE C15 Sand-Filled Plastic Barrels

Placement:

A space should be left behind the last row of modules so sand and debris will not be confined to produce a ramping effect on the vehicle. One or two feet are the minimum space requirements.

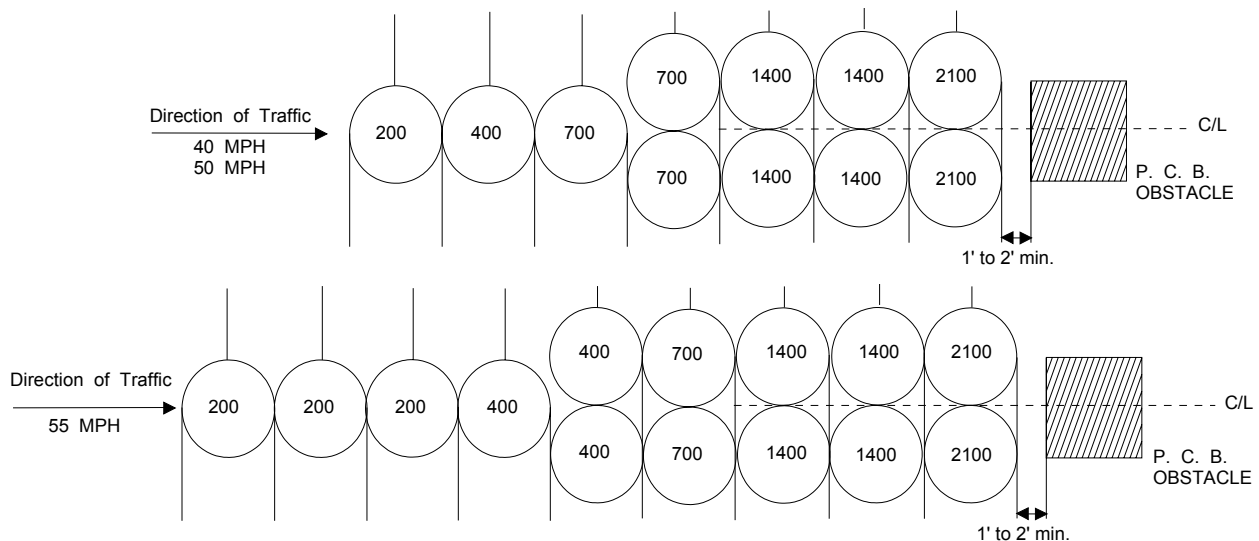
Sand

Moisture Content of the loose sand should be 3% percent or less and clean sand should be used to minimize caking. A significant variation in the density of the sand could have some effect on the performance of the crash cushion. If the sand contains a high enough moisture content and temperature remains below freezing for several days, the sand may freeze. Mixing a 5% percent (by volume) of rock salt with the sand will prevent wet sand from freezing under most conditions.



Configurations shown shall be used unless a barrel manufacturer requires a different configuration for the design or posted speed.

All Inertial Barrier should not exceed 36" inches in height.



C-16 Application of Drums, and Cones

Channelization (See Table II)

Within the system of traffic devices where a reduction in pavement width is involved, the single most important element is the taper that is provided for the channelization. An inadequate taper will almost always produce undesirable traffic operations with resulting congestion and potential accident hazard.

A minimum desirable taper length essential for smooth traffic operation is the posted speed limit times the width of the lane to be closed. For example, if a 12 foot lane is to be closed on a roadway with an existing 55 M.P.H. speed limit, the channelization to accomplish the transition shall be placed on a 55×12 or 660 ft. taper length.

For controlled access roadways, the minimum taper shall be 1,000 ft.

Adjustments may become necessary to provide adequate sight distance on the approach to the channelization. Similarly, the proximity of interchange ramps, crossroads, etc., to the work site may dictate the need for adjustments. In general, better traffic operations will result when the adjustments consist of increasing the length of the taper rather than reducing the length below the minimum desirable recommended above.

On construction, maintenance, or utility projects, channelization often remains in the same place for long periods of time. During such a long interval some of the elements, drums, cones etc., get out of their original alignment due to construction activities, etc. It is necessary, therefore to patrol the channelization at regular intervals to assure its proper functioning as a traffic control device. Replacement or shifting of the elements into the original alignment can best be done if the original positions of the elements are indicated on the pavement by paint marks. This technique assures good alignment and proper vehicle performance over a long period of time with minimum expenditure of men and materials in maintaining the channelization.

C-17 Placement of Drums and Cones

Drums, and cones used in tangent sections shall be placed at approximate right angles to the traffic flow and not more than 50 feet apart.

Drums, and cones used on tapers shall be placed at approximate right angles to the traffic flow and at not more than 25 feet intervals for the first four (4) devices in place.

Drums and cones shall be used in high speed and high volume areas to delineate non-normal travel paths.

C-18 Traffic Cones, Flexible Guide Markers Vertical Panels, or Drums

When cones, flexible guide markers, vertical panels, or drums are used, precautions are necessary to assure they will not blow over or become displaced. Added weights shall not be sufficient to present a hazard if the devices are inadvertently struck.

C-19 Type III Barricades

Construction, Maintenance or Utility

When a road section is closed to traffic, Type III barricades shall be erected at the points of closure. They may extend completely across a roadway and its shoulders as a fence, or from curb to curb, but where provisions must be made for access of equipment and authorized vehicles, the Type III barricades shall be provided with gates or movable sections that can be closed when work is not in progress, or with indirect openings that will discourage public entry. Where access is provided through the Type III barricades, responsibility shall be assigned to a person to assure proper closure at the end of each working day.

When a road or street is legally closed, but access must still be allowed for local traffic, the Type III barricade cannot be erected completely across a roadway. Instead, an arrangement should be devised that will permit local use but effectively discourage use by through traffic. A sign with the appropriate legend concerning permissible use by local traffic shall be installed. Applications of this principle are illustrated in the cases at the end of this Manual. (see page 50 for implementation)

C-20 Signs on Barricades

Barricades, particularly those of the fixed type, offer a most advantageous facility for the erection of signs. The Road Closed and Detour Arrow signs, and the large arrow warning signs, for example, can effectively be mounted above the barricade that close the roadway.

C-21 Maintenance or Utility Activities

A street or highway condition requiring maintenance is seldom of a character that will require a complete closing of the facility. When such a condition does occur, it is almost always an emergency situation, as would result from a broke water main or a washed out culvert, for example. Repair work is generally initiated on an emergency basis and the street or road closing generally uses plastic drums, flares, or cones.

C-22

TABLE II

NOTE: For controlled access roadways, the minimum taper shall be 1,000 ft. using 22 cones for the taper to close one lane.

POSTED SPEED LIMIT: M.P.H.						
	30	35	40	45	50	55
Length of Taper	420'	490'	560'	630'	700'	770'
Lane Width 14 Ft. 15 cones						
Distance Between Cones	30'	35'	40'	45'	50'	50'
<hr/>						
Length of Taper	360'	420'	480'	540'	600'	660'
Lane Width 12 Ft. 13 cones						
Distance Between Cones	30'	35'	40'	45'	50'	50'
<hr/>						
Length of Taper	330'	385'	440'	495'	550'	605'
Lane Width 11 Ft. 12 cones						
Distance Between Cones	30'	35'	40'	45'	50'	50'

D - LIGHTING DEVICES

D-1 Function

It is often desirable and necessary to supplement the reflectorized signs, barriers and channelizing devices with lighting devices that are available for the purpose indicated in the following paragraphs.

D-2 Electric Lights

Electric lights used in construction, maintenance, or utility areas may be flood lights, steady burning lights, or flashing lights.

A. Flood Lights

Construction, Maintenance, Utilities or Incident Management

Floodlights are used to light work activities, flagger stations and other restricted or hazardous areas at night when area lighting is not sufficient. Floodlights should be positioned or shielded to prevent glare to the drivers. The increased visibility provided by floodlighting may enable the driver to see distracting portions of the work area. In this case, steady burning warning lights mounted on channelizing devices may be advisable. Floodlighting the work area cannot be considered as illuminating signs or devices. Each illuminated sign or device should have its own light source.

During the planning and design of a street improvement project, consideration may be given to specifying that proposed street lighting be completed as one of the earlier stages during construction. Consideration should also be given for providing temporary luminaires at certain locations such as the work activity, certain crossroads, and transitions.

B. Hazard Identification Beacons

(Flashing Electric Lights)

A Hazard Identification Beacon generally is used at points of special hazard where the flashing beacon is effective in calling the attention to drivers to these locations. When used, the flashing beacon should operate 24 hours a day.

(1) Construction, Maintenance or Utilities

Because of the time and effort required to install and put the units into operation. Hazard Identification Beacons are used generally only at locations where frequent changes would not be required.

(2) Construction, Maintenance or Utilities

During normal day time operation, maintenance or utility operations, the functions of flashing beacons are adequately provided for by the lighting equipment on maintenance vehicles, either the emergency flashers, the rotating dome light, or both.

C. Steady Burning Electric Lamps

As used herein, steady burning electric lamps shall mean a series of low wattage yellow electric lamps.

D. Electrical Power to Operate Lights

The electrical power to operate the lights shall be supplied by either batteries or A.C. current. If A.C. current is used to supply the power necessary for the operation of the lights, it is required that a standby system using batteries be maintained to guarantee the automatic continuous operation of the lights in the event that a power failure should occur. The installation shall meet the National Electrical Code.

D-3 Lanterns or Flares

Lanterns and Flares are single unit, portable, constant burning, low intensity types of lights with open or enclosed flame. The flammable fuel used in the lanterns or torches may be a hazard to life and property, and their use, therefore, is not permitted.

D-4 Warning Lights

Warning lights are portable, enclosed lights. The color of the light emitted shall be amber or red as required elsewhere in this manual. They may be used in either a steady burn or flashing mode.

A. Type "A" low intensity flashing warning lights are most commonly mounted on portable barriers, drums, vertical panels, and are intended to continually warn drivers that they are approaching or proceeding in a hazardous area.

B. Type "B" high intensity flashing warning lights are intended to be mounted on advance warning signs and barricade installations.

Type "B" high intensity flashing warning lights, shall be maintained so as to be capable of being visible on a sunny day when viewed without the sun directly on or behind the device from a distance of 1,000 feet. This light shall be operational 24 hours a day.

C. Type "A" flashing warning light shall be maintained so as to be capable of being visible on a clear night from a distance of 3,000 feet, required operation dusk to dawn.

D. Lens directed warning lights shall be in accordance with the requirements of the latest ITE Standard for flashing and steady-burn barricade warning lights.

D-5 General Requirements - Barricade Lights

- A. The lens shall be self-illuminated by means of an electric lamp behind the lens. Type "A" also shall be externally illuminated by reflex-reflective element built into the lens to enable it to be seen by reflex-reflection of the light from the headlights of oncoming automotive traffic.
- B. When the unit is to be operated by batteries, they must be entirely enclosed in a case which is constructed of No. 18 U.S. standard gauge steel or any other material which by engineering judgement is considered capable of withstanding considerable abuse. The case must be secured by a locking device.
- C. When the unit is to be operated by a 120 volt, 60 cycle power supply, the unit shall be supplied with a separate ground wire and be protected with suitable fuses. At no time shall the effective intensity have a value greater than 500 candelas. The connections and equipment used shall be in accordance with the pertinent current standard of the Institute of Electrical and Electronic Engineers, the American Society for Testing Materials, and the National Board of Fire Underwriters. In those areas where there are pertinent local ordinances and requirements, the wiring, material and installation procedures shall comply with the local requirements. It is required that a standby power source be maintained to guarantee the automatic continuous operation of the lights.

D. (1) Swivel Head

If swivel capabilities as described in this Section are not incorporated in the device used to mount a Type "A" or Type "B" light to a barricade or sign, the head shall be mounted on the housing in a manner permitting it to be swiveled through a minimum 90o arc in a horizontal plane. If swiveling is to be accomplished by rotation of the head, construction shall be such that the head rotation will not damage the wiring.

(2) Housing

Definition - Housing is defined as the case containing the batteries and circuitry.

Material - The housing shall be constructed of No. 18 U.S. Standard Gauge Steel or any other material which by engineering judgement is considered capable of withstanding considerable abuse.

(3) Hoods

The hood shall have a nominal measurement of 4" from front to back.

(4) Photoelectric controls, if provided on Type "A" light, shall keep the light operating whenever the ambient light falls below 20 foot candelas.

D-6 Testing Quality and Marking of All Lights

A. Testing and Certification

- (1) If required by the purchaser, certification as to conformance to these specifications shall be furnished by the manufacturer based on results of tests made by independent testing laboratory.
- (2) If required by the purchaser, barricade warning lights furnished under this specification shall be tested in accordance with the latest revision of ASTA Test Procedures T-101. (American Traffic Service Association).

B. Quality

All electrical components, the quality of the materials used, and the workmanship of all lights furnished for use shall be the same as that of corresponding models approved under this specification.

C. Identification

Each light shall be plainly marked as to type and the manufacturer's name and model number in order to facilitate identification and approval.

D. Testing Procedures

Reflex-reflection shall be tested in accordance with S.A.E. Standard J 594d.

The lens shall not be less than seven inches (7") in diameter including a reflex-reflector ring of 1/2" minimum width around the periphery.

E. Number of Lens

- (1) Type "A" shall have either a bidirectional or unidirectional lens.
- (2) Type B shall have a unidirectional lens.

F. Lens Material

The lens shall be one - piece construction. The lens material shall be plastic capable of producing a lens that can meet the chromaticity and luminous transmission requirements of specification. The lens material shall meet the test requirements set forth in S.A.E. Standard 357b (Society of Automotive Engineers, Inc., "Lighting Equipment and Photometric Tests") except that the exposure time and conditions (S.A.E. Standard, Paragraph 3.4.3.) for the purposes of this standard shall be one year.

D-7 Lights on Channelizing Devices

There shall be minimum of one(1) Type "B" flashing amber lights on the first two devices in the series, except where otherwise noted. The last device in the series shall have one(1) Type "A" light.

At isolated hazards within a general construction, maintenance, and utility areas Type B flashers shall be used. Normally hazards more than 300 feet apart shall be considered isolated. However, the Traffic Engineer may determine otherwise.

Non-directional reflective panels can be used in lieu of lights on curb barrier at fifty (50) foot intervals. At least six (6) reflective panels shall be used in every case. (see D-9 for details)

Two (2) red Type "B" flashing lights shall accompany any stop sign mounted on a barricade or placed to stop traffic for construction, maintenance, or utility activity except manually operated signs.

When a roadway is closed to all traffic, two (2) Type "B" red flashing lights shall be mounted per travel lane facing oncoming traffic on and above the devices which completely close that travel lane.

When at least one lane of a roadway remains open to travel, two (2) Type "B" amber flashing lights shall be mounted per travel lane facing oncoming traffic on and above the devices which completely close any travel lane.

On two-way roadways, two (2) Type "B" amber flashing lights shall be mounted on and above the devices which close the travel lane nearest the lane open to travel.

D-8 Lights on Signs

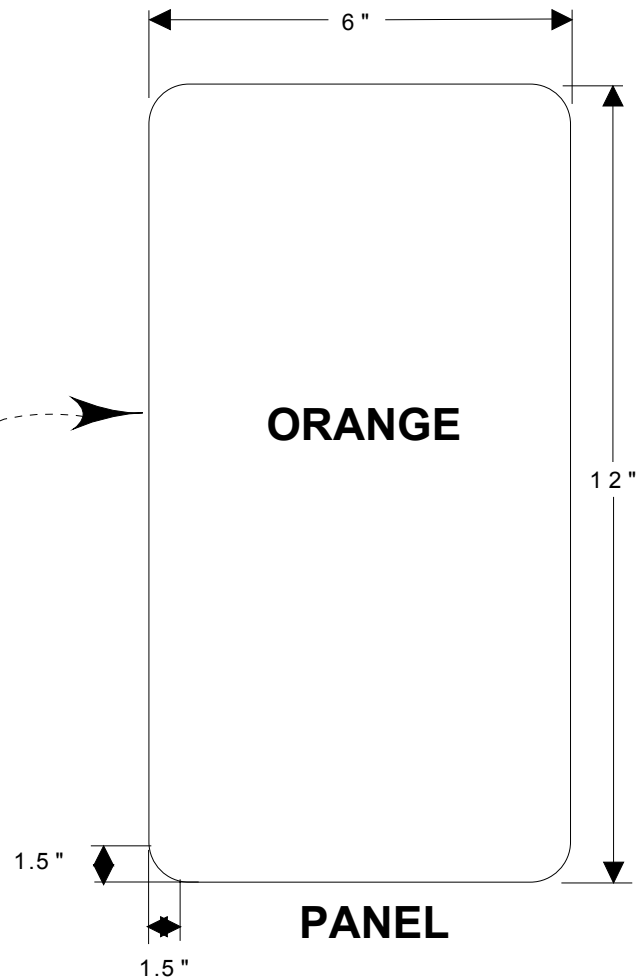
When used at night, or when specified by the Engineer, the first sign and the second sign in the series approaching a work area or project shall each have at least one (1) Type "B" amber flashing lights located above the center line of the sign unless the sign face is made of florescent orange "Extra Grade" material (see B-1). When the second sign in a series is rectangular two (2) Type "B" amber flashing lights shall be used and be mounted above the sign.

D-9 Non-directional Reflective Panel

Design

Non-directional Reflective Panel shall be 6 inches wide and 12 inches high with rounded corners. The Non-directional Reflective Panel shall have fluorescent orange 3M Extra Grade retroreflective sheeting, on both sides.

Durable "Extra Grade"
Fluorescent Orange,
Standard orientation



Application

Non-directional Reflective Panel can be used on curb barrier at fifty (50) foot intervals. There shall be at least six(6) reflective panels used in every case. The panels shall be attached to the portable barrier in such a manner as to prevent accidental removal. Bolts or epoxy based adhesives are acceptable. Other methods can be submitted for approval by the Engineer

NOTE:

On two(2) lane roads warning Non-directional Reflective Panel shall have reflective sheeting on both sides visible in both directions.

D-10 Traffic Control Signals

Traffic control signals may be used for special applications to control vehicular traffic movements at construction, maintenance or utility work areas. The installation may be temporary, portable or short term. The specifications here shall apply to every stop & go traffic control signal of whatever nature.

Typical applications include:

- A. A highway or street intersection with a temporary "haul road" or equipment crossing.
- B. Through areas requiring one way traffic operations.

All traffic signal and control equipment shall meet the applicable standards and specifications prescribed in the Department's Manual on Uniform Traffic Control Devices. Normally, these installations shall be operated by means of traffic actuation or manual control.

D-11 Portable Traffic Signal Operation

- A. Contractor shall submit a plan indicating the placement and operation of the portable traffic signals to the Chief Traffic Engineer for approval 10 days prior to use. Portable traffic signals must be of a type approved for use on construction/utility or maintenance operations required by the Chief Traffic Engineer.
- B. Additional signing and devices shall be installed as required by the Engineer.
- C. Portable traffic signals shall not be used where:
 - (1) Approaching speeds are greater than 50 M.P.H.
 - (2) Sight distance to the signals is less than required in the MUTCD.
 - (3) Overhead signals are required by field conditions.
- D. The operator must have an unobstructed view of both ends of the roadway segment being controlled when manual controls are in use.
- E. If the total distance between each pair of the traffic signals is greater than 1,000 feet or the operator's view of the signal head or traffic flow through the work zone is obstructed, under manual operation a separate operator is required at each end and communication must be maintained between the operators.
- F. Signal heads shall be a minimum of four feet off the edge of the travelway, and a minimum of eight feet from the bottom of the signal head to the roadway. A signal face shall be located on each side of roadway.
- G. Minimum change interval (yellow) is three seconds.
- H. Minimum clearance interval (red) is determined by the length of the area controlled by the traffic signals and speed of traffic flow through the work area.

- I. The location of the portable traffic signals may be modified, with the project engineer's approval to obtain the required visibility for both operator and motorists.
- J. All vehicles in the work area shall display flashing lights installed for the purpose of warning approaching drivers of a vehicular traffic hazard requiring unusual care in approaching, overtaking, or passing.
- K. Provide for alternate operation of the signal during period of failure, either flash, manually or by having manual traffic direction.
- L. Have properly skilled maintenance responding to the site within two hours of notification for all emergency calls. Lamp failure shall be responded by the next business day, in cases where redundant lamps exist. Provide adequate stand-by equipment to minimize the interruption of signal operation due to equipment failure.
- M. Provide properly skilled maintenance for all components.
- N. Maintain the appearance of the installation in a manner consistent with the intention of this manual, with particular emphasis on painting and cleaning of the optical system.
- O. Every controller should be kept in effective operation in strict accordance with its predetermined timing schedule.
- P. A careful check of the correctness of time operation of the controller should be made frequently enough to insure its operating in accordance with the planned timing schedule. Timing changes should be made only by authorized persons. A written record shall be made of all timing changes.
- Q. All Traffic Signal Equipment shall be carefully cleaned and serviced at least as frequently as specified by the manufacturer and more frequently if experience proves it necessary. The contractor/utility company or maintenance department must replace the lamps in accordance with the manufacturers recommendations and a record of this must be maintained by the contractor/utility company or maintenance department.

D-12 Flashing Lights on Vehicles

In many of the typical applications shown in this manual, there is reference to flashing lights on vehicles in the work area.

Any and all vehicles within the work area shall be equipped and display flashing lights as described below.

On expressways and other high volume, high speed roadways (above 50 m.p.h.) a light bar or other high powered strobe system is recommended and will be required after June 30, 1999.

The referenced flashing lights are not the vehicle emergency flashers, but a separate large rotating amber beacon or strobe light. Said beacon or strobe light shall be mounted on the vehicle in such a manner as to be clearly visible from all directions around the vehicle. These warning lights shall be visible from a distance of not less than 500 feet under normal atmospheric conditions at night.

D-13 Changeable Message Sign

Changeable message signs are capable of displaying various messages to the motorist. Their use will sometimes facilitate or supplement incident management, construction, maintenance or utility work zone signing.

Changeable message sign using Lamp Matrix shall not be used as alternate to arrow panel.

These devices are normally trailer or truck mounted and have their own power system.

Help with message content is available from either DelDOT Bureau of Traffic or DelDOT Safety Officers. In case of dispute the Chief Traffic Engineer has final authority over message content.

Messages, or series of messages can be preprogrammed into the device or can be added with an additional memory device; displaying panels may have one, two or three lines of copy.

When using this sign device the words should be chosen to ensure that the message is clear. A lengthy message may distract the motorist from his driving task for too long a time. One (1) second is required for a motorist to read each short word and only eight (8) seconds are available to read a message. Total message shall be no longer than eight (8) short words. The C.M.S. signs are especially useful in the following situations:

When different messages are needed during the day due to changing work operation.

For upstream traffic diversion when instructions vary with traffic conditions.

For emergency conditions.

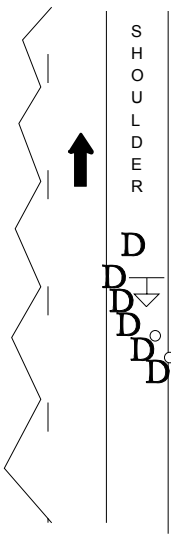
Some of the suggested guidelines for placement of the C.M.S.

Place approximately 3/4 mile in advance of the lane closure.

Place on same side of roadway as the closed lane for shoulder placement.


Six (6) channelizing devices (plastic drums or cones) are required for protection of the C.M.S.. See figure for placement of channelizing devices. If the unit will be on site at night, one (1) "B" amber light is required on the first two(2) channelizing devices (must be plastic drums).

Emergency operations of less than 48 hours duration may use reflectorized cones in lieu of drums and the two(2) "B" amber lights.




SYMBOLS

D Drums

 Changeable Message Sign
(bottom of all signs must be at least five(5) feet above roadway surface)

LIGHT SYMBOLS

 Type "B" amber high-intensity light

D-14 Crash Cushions

Crash cushions are devices designed to absorb the energy of an impacting vehicle in a controlled manner such that the impact forces on the passengers are tolerable. Two types of crash cushions commonly used in work zones are sand-filled plastic barrels and (see C-14, C-15 for proper placement) collapsible structures. Any device used must meet NCHRP 350 crash worthiness requirements.

Crash cushions should be designed to meet the needs of each location, depending on the type, length and width of the hazard and this information should be included on the highway construction plans. They are used to protect traffic from hazard, such as exposed barrier ends or bridge parapets.

Crash cushions should be installed and maintained in accordance with manufacturers recommendations. Crash cushions that are impacted should be promptly inspected and repaired or replaced. A supply of replacement parts should be available for prompt repair.

D-15 Truck Mounted Attenuator (TMA)

The TMA is a light weight attenuator system designed for installation at the back of highway maintenance and service trucks. The attenuation capability of the TMA provides a safety crash cushion between approaching traffic and highway crews.

When impacted head-on at highway speeds by errant vehicles within the weight range of 2,250 to 4,500 pounds, the TMA shall be able to:

- A. Decelerate the errant vehicle to a tolerable speed.
- B. Reduce the acceleration and roll ahead movements of the truck.
- C. T.M.A.'s used at a site shall be crash rated for the posted speed limit of that site.
- D. T.M.A shall not be located closer to the work area than as defined by the T.M.A. manufacturer nor located at a distance to no longer protect the work area.

T.M.A.

Truck Mounted Attenuators are required on all limited access highways and on all highways which have four or more lanes with the posted speeds of 45 M.P.H. or greater, and on all U.S. routes (except U.S. 9) for the following operations:

- 1 - pavement marking
- 2 - roadside spraying
- 3 - patching
- 4 - rotomilling
- 5 - portable barrier placement
- 6 - other situations where the Engineer or authorized representative feel such protection is warranted.

Application

The TMA shall be employed whenever construction, utility, or maintenance activities within ten (10) feet of the travelway, not protected by safety barriers, present a hazard to motorists or the workers as determined by the Engineer.

D-16 Shadow Vehicles

Moving operations, such as lane striping or sweeping, need traffic controls that move with the work operations. Shadow vehicles may be used to assist traffic control for moving operations. Signs and other warning devices may be placed on the work vehicle (depending on the type of work) or the shadow vehicle, or both. Need for a shadow vehicle depends on the speed of traffic compared to the speed of the work vehicle, exposure to traffic of workers and the type of work activity. Portable crash cushions can be attached to the shadow vehicle to protect motorists and workers from a collision. Signs, flags, flashing lights, or arrow panels may be attached to shadow vehicles to warn traffic. Arrow panels may be used on multilane highways but should not be used on a two-lane, two-way road.

D-17 Arrowpanels

Acceptability depends upon the distance over which the message is clearly conveyed. Any arrowpanels submitted for approval must be at least as clear and as strong as the herein described panels at any given distance in a side by side comparison. Approval prior to installation and or use is required.

Arrowpanels shall have a rectangular panel face or background finished in nonreflective black. Mode selection shall include Left Arrow, Right Arrow, Left and Right Arrow, and Caution. The Caution mode shall consist of four (4) or more lamps arranged in a pattern which will not indicate a direction. Mode selection controls shall include a lamp intensity adjustment capable of dimming lamp output a minimum of 50 percent. The flashing rate of the lamps shall not be less than 30 times per minute, nor more than 40 per minute.

Arrowpanels may be trailer mounted, vehicular mounted, or mounted on any suitable support. If panel is vehicular mounted, the controls shall be remotod to the cab and positioned within arms reach of the operator.

Arrowpanels enhance the effectiveness of other traffic control devices by providing a high impact directional message to the approaching driver. To the extent that they attract attention and provide information, they assist in directing and or controlling traffic around work sites on or adjacent to the travelway.

Arrowpanels are not to be used in lieu of other traffic control devices except as specifically authorized.

An arrowpanel may be used as the sole traffic control device under any emergency condition until a complete system of devices can be installed.

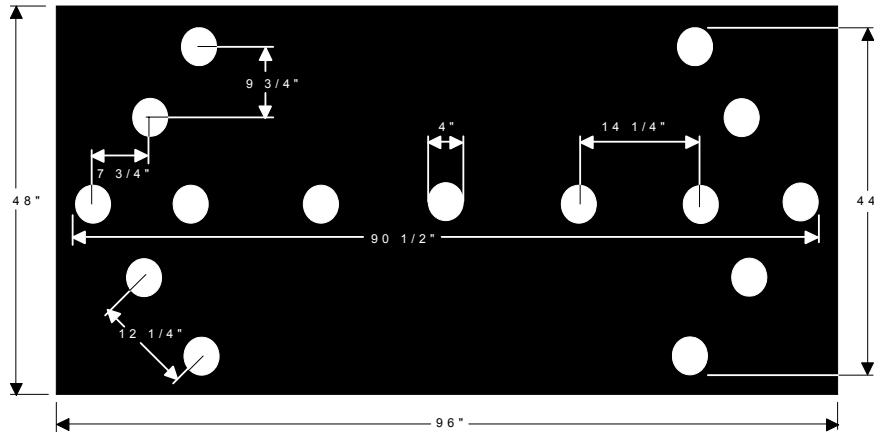
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Type "A" Arrowpanels are appropriate for use on low speed urban streets. Type "B" Arrowpanels are appropriate for intermediate speed facilities and for maintenance, or mobile, operations on high speed roadways. Type "C" Arrowpanels are intended to be used on high speed, high volume traffic control projects. Arrowpanels of any size will not be used on a two lane road to indicate a lane transition where a conflict with vehicles approaching from the opposite direction will be created. Arrowpanels should not be used for shoulder or roadside work except in caution mode. The caution mode consists of four or more lamps arranged in a pattern which will not indicate a direction.

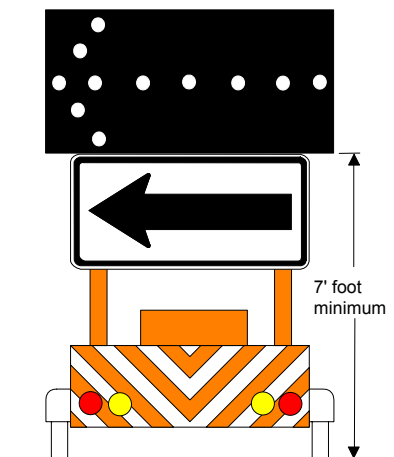
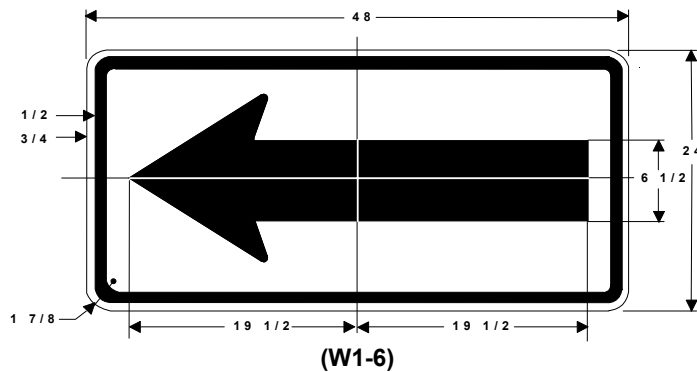
For stationary lane closures, the arrowpanel should be placed on the shoulder at the beginning of the taper, or where there are narrow shoulders in the closed lane behind the channelizing devices on the same side the lane closure. Placement at the start of the taper is preferred to placement in the middle of the taper.

Arrowpanels are traffic control devices which are capable of projecting an image of an arrow toward approaching vehicles. There are three approved configurations:

TYPE	OVERALL SIZE	NUMBER OF LAMPS	SIZE OF LAMPS DIAMETER	Minimum Legibility Distance (miles)
A	24"x48"	12	4" minimum	1 / 2
B	30"x60"	13	4" minimum	3 / 4
C	48"x96"	15	4" minimum	1



(W1-6) CENTERED AND ATTACHED TO BOTTOM OF ARROWPANEL



FOR THIS APPLICATION THE W1-6 SIGN SHALL BE OF "DIAMOND GRADE" MATERIAL.

E - CONTROL OF TRAFFIC THROUGH WORK AREAS

E-1 Function

The primary function of traffic control procedures is to move traffic safely and expeditiously through or around work areas.

The control of traffic through work areas is an essential part of highway construction, maintenance and utility operations. For these operations, there must be adequate authority for the implementation and enforcement of needed traffic regulations, parking controls and speed zoning. Such authority must provide sufficient flexibility in the application of traffic control to meet the needs of the changing conditions in work areas.

E-2 Hand Signaling Devices

A number of hand signaling devices, such as stop/slow paddles, lights and red flags are used in controlling traffic through work zone. The sign paddle bearing the clear message stop or slow provides motorists with more positive guidance than flags and should be the primary hand signaling device. Flags used shall be limited to emergency situations.

Sign paddles shall be octagonal in shape and at least 24 inches wide, with a minimum of 6 inch series C letters. It is recommended that 8 inch series C letters be used for the "STOP" side and 8 inch series B letters be used for the "SLOW" side. These dimensions will be required after January 1, 2000. A rigid handle shall be provided such that the bottom of sign paddle will be 6' above ground. This combination sign may be fabricated from sheet metal or other light semi-rigid material. The background of the STOP face shall be red with white letters and border. The background of the SLOW shall be orange with black letters and border. The STOP face shall be reflectorized red with white reflectorized letters and border, and the SLOW face shall be reflectorized orange with black letters and border. The reflective sheeting used for both faces shall meet the specifications in B-1 for "Hi Intensity".

Flags shall be used only in emergency situations or within an intersection while the intersection remains under signalized control. In the intersection case the flagger is only directing traffic around an obstruction while the signal provides actual control. If the flagger is controlling the intersection, the signal shall be on flash or dark, and each approach shall be controlled by a flagger using the STOP/SLOW paddle.

Flags used for signaling purposes shall be a minimum of 24 by 24 inches in size, made of a good grade of red material securely fastened to a staff approximately 3 feet in length. The free edge should be weighted to insure that the flag will hang vertically, even in heavy winds.

When a sign paddle is used, it shall be held in a stationary position with the arm extended horizontally away from the body.

Except in emergency situations, flood lights shall be used to illuminate flagger stations during night time operations.

Whenever practicable, the flagger should advise the motorist of the reason for the delay and the approximate period that traffic will be halted. Flaggers and operators of construction, maintenance or utility machinery or trucks should be made to understand that every reasonable effort must be made to allow the driving public the right of way and prevent excessive delays.

E-3 Flaggers

Since flaggers are responsible for human safety and make the greatest number of public contacts of all construction, utility and maintenance personnel, it is important that qualified personnel be selected. A flagger shall possess the following qualifications:

- A. Average intelligence
- B. Good physical condition, including sight and hearing
- C. Mental alertness
- D. Courteous, but firm manner
- E. Neat appearance
- F. Sense of responsibility for safety of public and crew

Personnel working as flaggers shall wear orange colored clothing on the upper portion of the body, or an approved vest. Flaggers shall wear the appropriate orange colored head gear at all times. For nighttime conditions similar outside garments shall be reflectorized.

Flaggers are provided at worksites to stop traffic intermittently as necessitated by work progress or to maintain continuous traffic past a worksite at reduced speeds to help protect the work crew. For both of these functions the flagger must, at all times, be clearly visible to approaching traffic for a distance sufficient to permit instructions, and to permit traffic to reduce speed before entering the worksite. In positioning flaggers, consideration must be given to maintaining color contrast between the work area background and the flaggers protective garments.

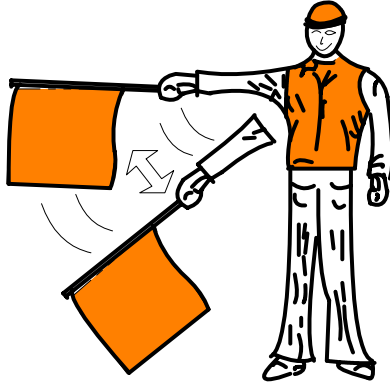
Individuals working as flaggers shall be properly and modestly attired for a work site. The absence of attire or the wearing of abbreviated or suggestive attire, including shorts above the knee and halter tops or attire which is subject so as to create a danger or inadvertent snagging by vehicles and/or equipment is prohibited. As a minimum, the flagger shall wear a T-Shirt with short sleeves and long pants down to the ankles.

The flagger shall not:

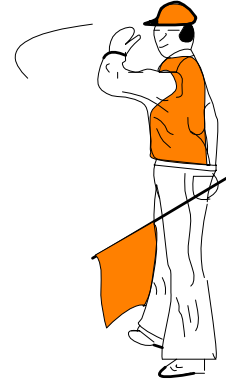
- A. Mingle with the crew when work is being performed
- B. Leave his/her post unless authorized to do so
- C. Turn his/her back on approaching traffic
- D. Sit or stand in the shade or stand in front of equipment while on duty



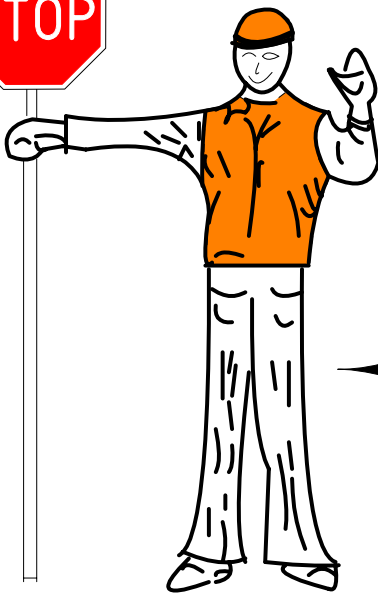
TO STOP TRAFFIC



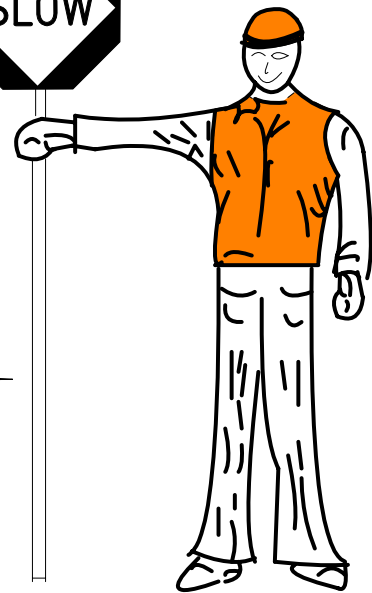
TO ALERT AND SLOW TRAFFIC



TRAFFIC TO PROCEED



TO STOP TRAFFIC



TO ALERT AND SLOW TRAFFIC

← PREFERRED →

E-4 Flagging Procedures

The following methods of signaling with a Stop/Slow paddle or flag shall be used:

A. To Stop Traffic

The flagger shall face traffic and extend the STOP sign paddle in a stationary position with the arm extended horizontally away from the body. The free arm is raised with the palm toward approaching traffic.

The flagger shall face traffic and extend the flag horizontally across the traffic lane in a stationary position so that the full area of the flag is visible hanging below the staff. For greater emphasis the free arm may be raised with the palm toward approaching traffic.

B. When is it Safe for Traffic to Proceed

The flagger shall face traffic with the SLOW sign paddle held in a stationary position with the arm extended horizontally away from the body. The flagger motions traffic ahead with the free hand.

The flagger shall stand parallel to the traffic movement, and, with flag arm lowered from view of the driver, motion traffic ahead with a free arm. Flags shall not be used to signal traffic to proceed.

C. Where is it Desired to Alert or Slow Traffic

The flagger shall face traffic with the SLOW sign paddle held in a stationary position with the arm extended horizontally away from the body.

The flagger shall face traffic and wave the flag in a sweeping motion shall be for alerting drivers to be prepared for further instructions including the need to slow or stop.

E-5 Flagger Stations

There are two basic types of flag stations - approach speed control and intersection control. Approach speed control stations shall be located far enough in advance of the work site so that approaching traffic will have sufficient distance to reduce speed before entering the project. This distance is related to approach speed and physical conditions at the site; however, 500 feet is desirable. In urban areas when speeds are low and streets closely spaced the distance necessarily must be decreased.

The flagger should stand either on the shoulder adjacent to the traffic being controlled or in the barricaded lane. A "spot" obstruction, the flagger may have to stand on the shoulder opposite the barricaded section to operate effectively. Under no circumstances shall a flagger stand in the lane being used by moving traffic. The flagger shall be clearly visible to approaching traffic at all times. For this reason, the flagger must stand alone, never permitting a group of workmen to congregate around. The flagger shall be stationed sufficiently in advance of the work force to warn them of approaching danger such as out of control vehicles.

For intersection control the flagger should stand either on the shoulder adjacent to the traffic being controlled or in the barricaded lane. Once traffic has stopped, it may be necessary to move into the stopped lane so as to adequately control conflicting traffic. The flagger shall be clearly visible to the moving traffic lane. For this reason, the flagger must stand alone, never permitting a group of workmen to congregate around.

Flag stations must be adequately protected and shall be preceded by proper advance warning signs. At night, flag stations shall be adequately illuminated with either light plants or other roadway lighting of 400 watt HPS or greater centered at the flagger station.

When flagging operations are in the proximity of a railroad crossing where queue lengths may extend over the crossing, an additional flagging station shall be placed at the crossing to ensure that the queue does not stop on the tracks.

E-6 One Way Traffic Control

Where traffic in both directions must, for a limited distance, use a single lane, provision should be made for alternate one-way movement to pass traffic through the constricted section. At a "spot" obstruction, such as an isolated pavement patch, the movement may be self-regulated. However, where the one lane section is of any length, there should be some means of coordinating movements at each end so that vehicles are not simultaneously moving in opposite directions in the section so that delays are not excessive at either end. Control points at each end of the route should be chosen so as to permit easy passing of opposing lines of vehicles.

E-7 Flagger Control

Where the one lane section is short enough so that each end is visible from the other end, traffic may be controlled by means of a flagger at each end of the section. One of the two should be designated as the chief flagger for purposes of coordinating movement. They should be able to communicate with each other verbally or by means of signals. These signals should not be such as to be mistaken for flagging signals.

Where the end of a one lane section is not visible from the other end, the flagger may maintain contact by means of radio or field telephones. So that a flagger may know when to allow traffic to proceed into the section, the last vehicle from the opposite direction can be identified by description or license.

E-8 Flag Carrying or Official Car

Flag carrying is effective when the route is well defined and non-hazardous. It should be employed only when the one way traffic is confined to a relatively short stretch of road, usually not more than one mile in length.

The driver of the last vehicle proceeding into the one lane section is given a red flag (or other token) and instructed to deliver it to the flagger at the other end. The opposite flagger, upon receipt of the flag, then knows that it is safe to allow traffic to move in the other direction. The flag being carried should always be clean and dry.

A variation of this method is the use of an "official" car which always follows the last vehicle proceeding through the section. The use of an official car eliminates the possibility of loss of the flag.

E-9 Pilot Car

The use of a pilot car for traffic control can be most effective where the route is particularly hazardous, or so involved or frequently altered as to preclude adequate signing. The pilot car is used to guide a train of vehicles through the job or detour. Its operation must be coordinated with flagging operations or other controls at each end of the one lane section. Sufficient turn around room should be provided at these points. Provisions should be made for identification of the last vehicle in the column. The Pilot Car sign shall be mounted on the rear of the vehicle.

E-10 Traffic Signs

Where the one lane section is short enough so that each end is visible from the other end, traffic may be controlled by means of signs at each end of the section. Typical special signing situations are illustrated in this manual.

E-11 Pavement Markings

Definitions

1. LANE LINE: Lines of marking material placed between lanes of traffic moving in the same direction.
 2. EDGE LINE: Lines of marking material placed on the right-hand side of a travel lane with two way traffic and on both sides of a traveled way having one way traffic.
 3. CENTER LINE: Lines of marking material placed between lanes of traffic traveling in opposite directions.
 4. NO PASSING ZONES: Roadway sections where passing to the left is prohibited by a pattern of pavement markings.
 5. DETOUR MARKINGS: Markings which are placed to cause or require traffic to move from the normal or previous travel path. ALL DETOUR MARKINGS SHALL BE INSTALLED USING STANDARD MARKING PATTERNS.
 6. STANDARD MARKING PATTERNS: Complete marking sets as required for the complete marking of roadways in the MUTCD.
 7. TEMPORARY MARKINGS: Marking patterns which are abbreviated in nature due to the short time they are allowed in service.
 8. INTERMEDIATE MARKINGS: Standard marking patterns which are placed on sublifts of paving materials or on final travel surfaces, but which are not the final markings. Intermediate markings include all centerlines, edgelines, stop bars, arrows, lane lines, etc. (Edgelines are not required unless the markings will be in place more than 28 calendar days or over the winter, or if directed by the Engineer).
 9. FINAL MARKINGS: Standard marking patterns which are placed on the final travel surface. These markings are to be placed using approved materials. Final markings shall always be applied in accordance with the Manual of Uniform Traffic Controls.
- A. Existing Pavement Markings: When long term work necessitates vehicle paths other than in the lanes normally indicated by existing pavement markings, checks should be made to evaluate the possibility that the pavement markings will not inadvertently lead drivers into barricades and/or work sites. Where necessary, these markings should be obliterated or removed. Painting over existing pavement markings does not meet the requirements for obliteration or removal. Approved removable masking tape may be used to temporarily obliterate existing pavement markings.

B. Application at Work Areas

Proper and consistent pavement markings are important to the driver, as he places a high priority on what he sees on the pavement. Centerline, lane and edgeline markings provide excellent path guidance, which is of particular importance in tapers, crossovers and runarounds. Edgelines used to supplement channelizing devices will continue to function, even if the devices have been knocked down.

C. Specification for Removable Preformed Retroflective Pavement Marking for Construction, Maintenance, and Utility Work Zones

(1) General

This specification is for markings which must be readily removed when they are no longer applicable. They shall be capable of performing for the duration of a normal construction season and shall then be capable of being removed intact or in large pieces either manually or with a recommended roll up device.

The preformed markings shall consist of white or yellow reflectorized film on a conformable backing.

The size, quality, and refractive index of the glass beads shall be such that the performance requirements for the markings shall be met. The bead adhesion shall be such that beads are not easily removed when the material surface is scratched with a thumbnail.

The pigments shall be selected and blended to provide pavement markings which are white or yellow, conforming to standard highway colors.

The markings shall be precoated with a pressure sensitive adhesive and shall be capable of being adhered to asphalt, concrete, or Portland cement concrete in accordance with manufacturer's instructions without the use of heat, solvents, or other additional adhesive means, and shall be immediately ready for traffic after application.

The markings shall be provided in specified shapes and widths. Performed words and symbols shall conform to the applicable shapes and sizes as outlined in the, "Delaware Manual on Uniform Traffic Control Devices for Street and Highways".

The materials shall be packaged in accordance with accepted commercial standards and when stored in a cool dry area indoors, shall be suitable for use for one year after date of purchase.

(2) Requirements

Composition: The removable preformed pavement marking film shall consist of a mixture of high quality polymeric materials, pigments, and glass beads, with a reflective layer of beads bonded to the top surface.

Reflectance: The white and yellow films shall have the following initial minimum reflectance values at 0.2o and 0.5o observation angles and 86.0o entrance angle as measured in accordance with the testing procedures of Federal Test Method Standard 370. The photometric quantity to be measured shall be specific luminance (SL)*, and shall be expressed as millicandelas per square foot per foot candle (mod.ft-2).fc-1). The metric equivalent shall be expressed as millicandelas per square meter per lux. The test distance shall be 50 ft. (15m) and the sample size shall be a 2.0 x 2.5 ft. rectangle (0.61x0.76 m).

The angular aperture of both the photoreceptor and light projector shall be 6 minutes of arc. The reference center shall be the geometric center of the sample, and the reference axis shall be taken perpendicular to the test sample.

	<u>White</u>		<u>Yellow</u>	
<u>Observation Angle</u>	<u>0.2o</u>	<u>0.5o</u>	<u>0.2o</u>	<u>0.5o</u>
SL (mod.ft-2).fc-1)	1770	1270	1310	820

"The quantity SL (specific luminance) treats the retroreflector as a surface source (rather than a point source) whose projected area is visible as an area at the observation position. The quantity SL related to the way the effective retroreflective surface is focused on the retina of the human eye and to the visual effect thereby produced. It is recommended for describing the performance of highway signs and striping, or large vehicular markings which are commonly viewed as discernible surface areas". Federal Test Method Standard 370, 3.1.2, Note 6. March 1, 1977.

Adhesion: The manufacturer shall be required to demonstrate that the properly applied pavement marking adheres to the roadway under climatic and traffic conditions normally encountered in the construction work zone.

Removability: The marking film shall be removable from asphalt and Portland cement concrete intact or in large pieces, either manually or with a roll-up device, at temperatures above 40F (4oC) without use of heat, solvents, grinding, or blasting. The manufacturer shall certify that the marking film has met this requirement after traffic exposure based on transverse test decks with rolling traffic.

Skid Resistance: The surface of the marking film shall provide an initial minimum skid resistance value of 50 BPN when tested according to ASTM E303-74.

D. Temporary Markings

Temporary Markings are an abbreviated pattern of pavement markings which may be warranted for short term use as specified below. They are appropriate only when both the scheduled and actual period of use are within the time specified. Upon a determination that such use period will extend, or has extended beyond the specific period, standard markings shall immediately be installed, as applicable to the then existing traffic situation.

Temporary Markings may be installed using paint, tape or individual reflector units (raised pavement markers, or RPM's).

E. Marking Installation

(1) General

All inappropriate existing pavement markings shall be removed and lane markings and center markings of the type required shall be in place before the work day ends. Whenever the work day is interrupted by weather, markings shall be made as complete as possible. They shall be completed as soon as possible thereafter including weekend or holiday work if necessary.

All markings shall be fully reflectorized. They shall be replaced as necessary to maintain acceptable levels of daytime and nighttime reflectivity.

All marking materials shall be installed in accordance with the manufacturer's recommendation using equipment designed for this purpose. The equipment shall be designed and constructed to satisfy the requirements of the National Board of Fire Underwriters and appropriate state laws, including those of size and weight restrictions.

The markings shall be protected until track-free by placing guarding or warning devices as necessary. In the event any vehicle should cross the markings before track-free, such marking shall be reapplied and any markings made by the moving vehicle shall be removed.

The markings shall be installed in a pattern and color that matches the pattern which existed prior to the start of the work or as directed by the Engineer.

The materials to be used must be approved by the Department prior to installation.

(2) Centerline

- a. AADT up to 1000 vehicles per day with an operational duration of three or less calendar days-Temporary Marking consisting of a 4 foot stripe on 40 foot center is permitted. Roadways with severe curvature may warrant the use of standard markings or a 2 foot stripe on 20 foot centers.
- b. AADT greater than 1000 vehicle per day or duration of four or more calendar days-Intermediate Markings consisting of a 10 foot stripe on 40 foot center is permitted.
- c. No passing zones shall be solid yellow stripes as specified by the MUTCD, except that where Temporary Markings are permitted, no passing zones may be identified by signs if permitted by the Engineer, but not longer than 3 days in any case.

(3) Lane Line

- a. AADT up to 1000 vehicles per day with duration of three or less calendar days - 4 foot stripe on 40 foot center permitted.
- b. AADT greater than 1000 vehicles per day or with an operational duration of four or more calendar days - Intermediate Markings consisting of a 10 foot stripe on 40 foot center is permitted.

(4) Edge Line

- a. Edge Line markings, when used, shall be solid stripe.
- b. Unless specifically set forth in the plans, or directed by the Engineer, edgelines are not required.

(5) Raised Pavement Markers (RPM's)

- a. A combination Raised Pavement Marker (RPM)/ stripe system is permitted for left edge line on multi-lane roads. RPMs or combination RPM/ stripe shall not be used for right edge line markings. They may be used when it is obvious to the motorists that such markings are for delineation and are not intended to mark a lane line. Examples include: ramps, gores, bifurcations, narrow bridges, detours, or at spot hazards. When used with edge line stripes, RPMs should be placed on the traffic side of the edge line stripe.
- b. RPMs having self-adhesive (or other) backing may be used in lieu of or to supplement other pavement markings.

- 1. When RPMs are used to simulate a line, spacing is as follows:

- (a) Broken Line-Four reflective RPMs on 3 1/3 foot centers with a 30 foot gap (or equal).
 - (b) Solid Line - Reflective RPMs on 5 foot centers. However, up to a 10 foot spacing may be acceptable if approved by the Engineer.
 - (c) Double Solid Line - Same pattern as solid line except two lines 3 to 4 inches apart.

Note: When RPMs are used to simulate a line they must be visible both day and night.

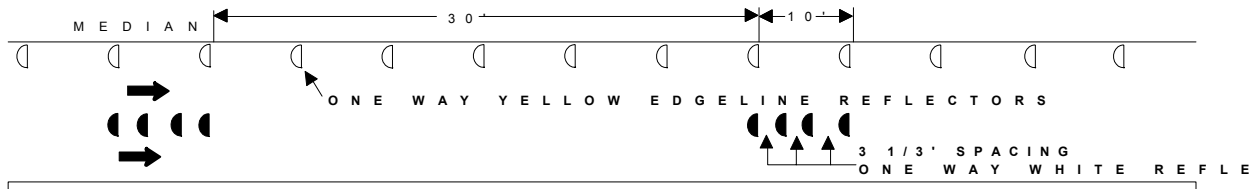
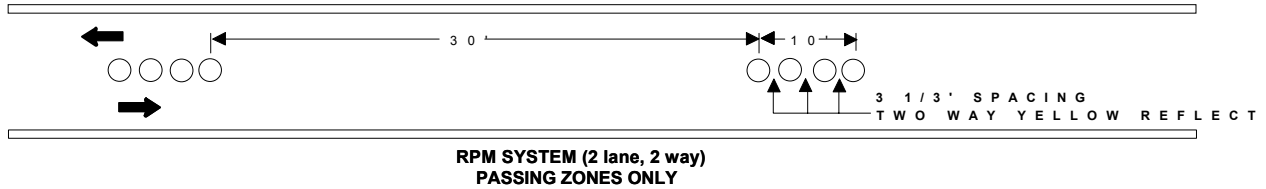
- 2. Where RPMs are used to supplement a line, recommended spacing is as follows:

- (a) Broken Lines - Reflective RPMs at center of gap.
 - (b) Solid Line - Reflective RPMs on 40 foot centers 2 to 3 inches to the side of the stripe supplemented.
 - (c) Double Solid Line - Same pattern as solid line except two lines of RPMs (outside striped lines - both sides). Recommended spacing on transitions, painted islands or medians, and curves 60 or more is 20 foot centers.



3. Listed below are guidelines for the use of temporary RPMs in Construction, Maintenance, or Utility Work Zones:
 - (a) The RPMs shall not be used during the winter months, when there may be damage or removal by snow plow blades.
 - (b) The RPMs shall not be used to indicate a no passing zone. A solid yellow line shall be used with the required signs.
 - (c) White RPMs shall not be used for edgelines.

**STANDARD DESIGN
TYPICAL APPLICATION OF TRAFFIC CONTROL DEVICES
FOR
HIGHWAY CONSTRUCTION AND MAINTENANCE**




**RAISED PAVEMENT MARKERS
(CONSTRUCTION ZONES)**



SYMBOLS

-  Traffic Flow
-  White Stripe

SYMBOLS

-  2 Way Yellow RPM
-  1 Way Yellow RPM
-  1 Way White RPM

F - EXPRESSWAYS AND LIMITED ACCESS FACILITIES

F-1 Application of Standards

Serious problems of traffic control occur under the special conditions encountered where traffic must be moved through or around maintenance or construction operations on high-speed, high volume facilities. Although the general principles outlined in the previous sections of this Manual are applicable to all types of highway facilities, special consideration must be given to high-speed and limited access-type of highways to accommodate traffic in a safe and efficient manner and for adequate protection of work forces. The density of traffic on these facilities requires that traffic control procedures be implemented, for example, to permit critical merging maneuvers to occur well in advance of work areas and in a manner which creates minimum turbulence in the traffic stream. These situations may require a much higher type of device than specified for normal rural or urban street use. The same important basic considerations of uniformity and standardization of general principles apply, however, for all facilities.

F-2 Signs

The messages of most of the standard warning signs described previously are applicable; however, signs larger than 48"x 48" may be desirable for additional emphasis. For large signs, a rectangular shape may be justified with approval of the Department. Movable signs mounted on trucks or trailers with specially constructed lighting units provide a means of giving additional advance warning to motorists. Requirements may exist for placing advance signs at 1/2, 1, or even 2 miles from the work site to inform traffic of possible delays.

A complete series of warning signs is generally required on both sides of the roadway for lane closures or where other restrictions to traffic flow may be encountered.

F-3 Barricades and Channelization

The direction of freeway type traffic through or around work sites requires the use of prominently positioned drums and delineation devices for establishing tapers for lane closures or other situations where traffic must divert from its normal path. The success or failure of a lane closure will often depend upon the ability of traffic in a closed lane to merge with the adjacent lane. In practice, this merge does not usually take place until the taper drums, cones or other devices are encountered. For this reason, the taper length must be sufficiently long to give drivers every opportunity to find an acceptable gap in the adjacent lane before having to slow down or stop and impede other traffic. Under relatively normal conditions of speed and volume, where adequate warning of a lane obstruction has been provided, the taper rate described should be sufficient. However, this length should be adjusted as required by traffic operations.

F-4 Lighting Devices

The need for adequate lighting devices is essential on high-speed facilities to maintain safe traffic flow. Flashing lights should be added to all advance warning signs. The complete illumination of night work areas should be considered.

F-5 Flags

Two(2) each flags;
size - flag - 24 inch x 24 inch
standard - three(3) foot
flag color - red or orange

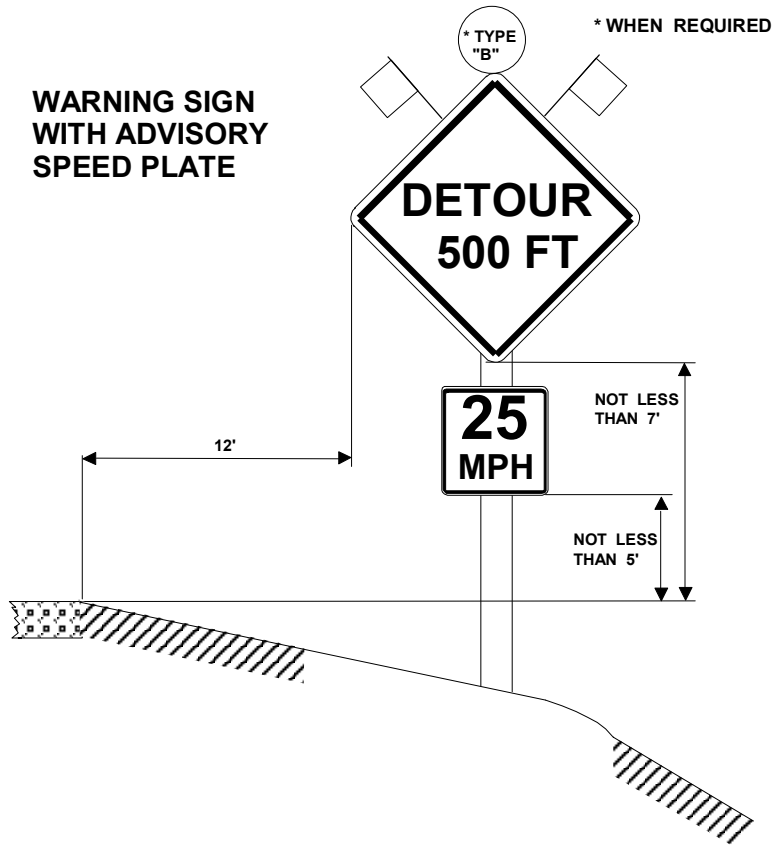
When Specified they shall be placed above each warning sign in Work Zone.
Open mesh flags will not be acceptable.

NOTES

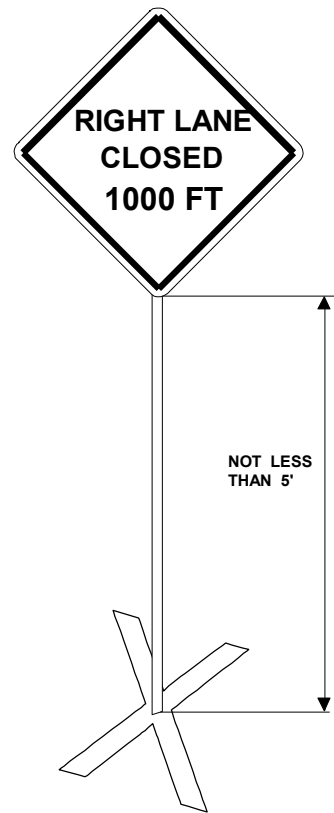
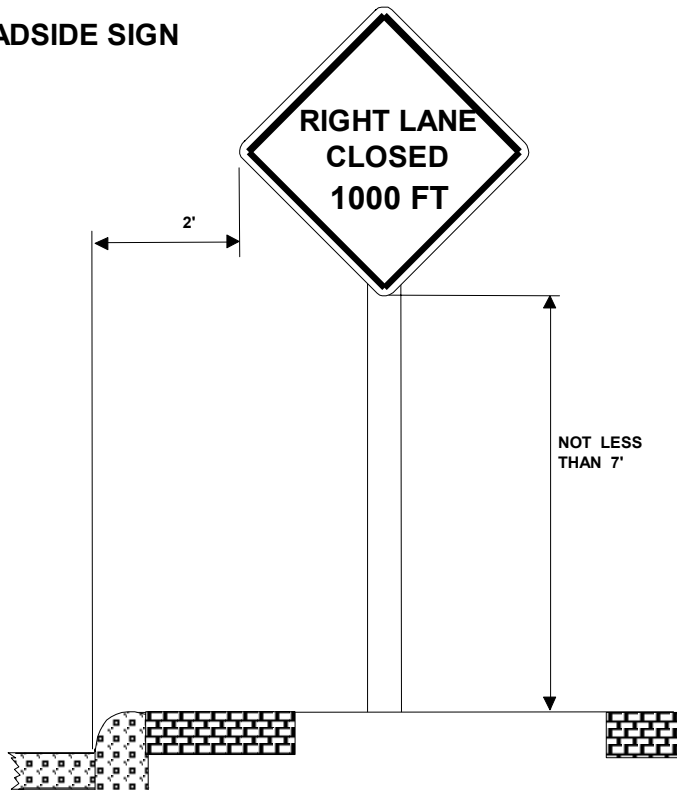
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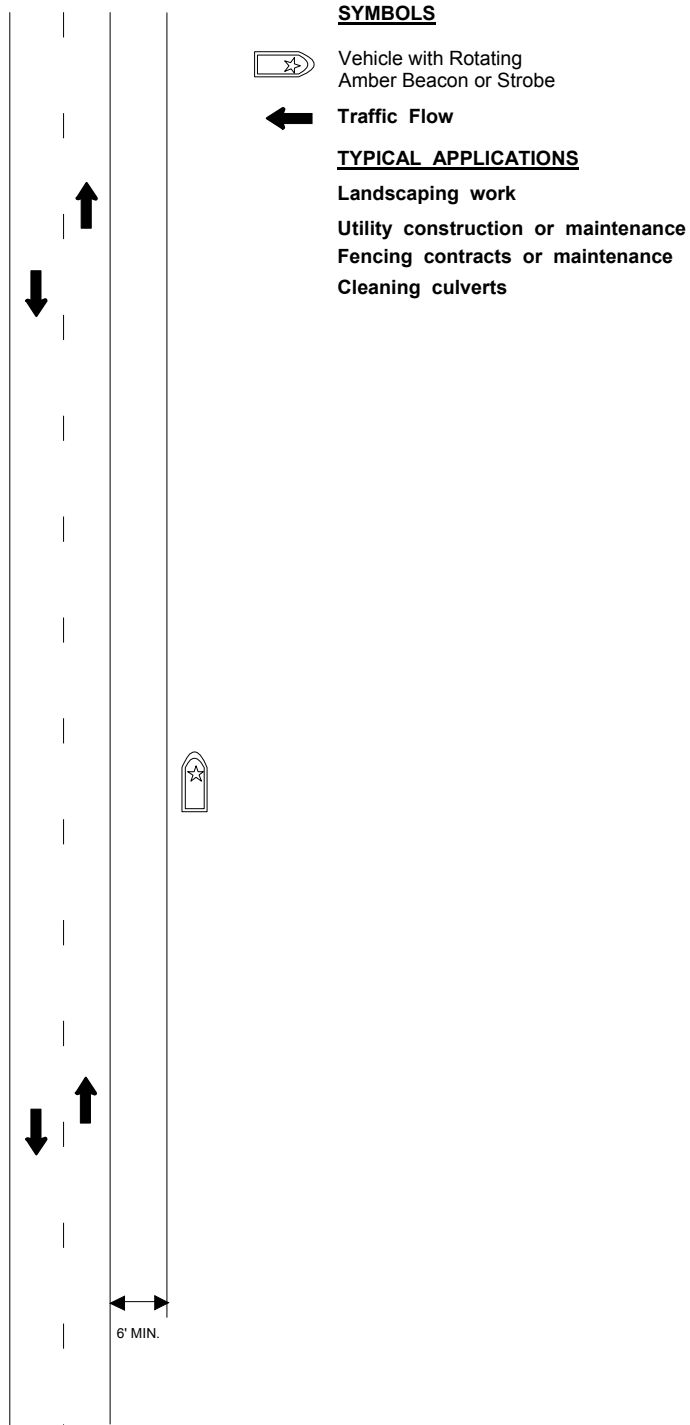
**WARNING SIGN
WITH ADVISORY
SPEED PLATE**



ROADSIDE SIGN



STANDARD DESIGN
TYPICAL APPLICATION OF TRAFFIC CONTROL DEVICES FOR
HIGHWAY CONSTRUCTION, MAINTENANCE AND UTILITY OPERATIONS
CASE 1
TWO-LANE, TWO-WAY TRAFFIC, DAY OR NIGHT OPERATIONS
OVER 6 FEET FROM EDGE OF PAVEMENT



CASE 1

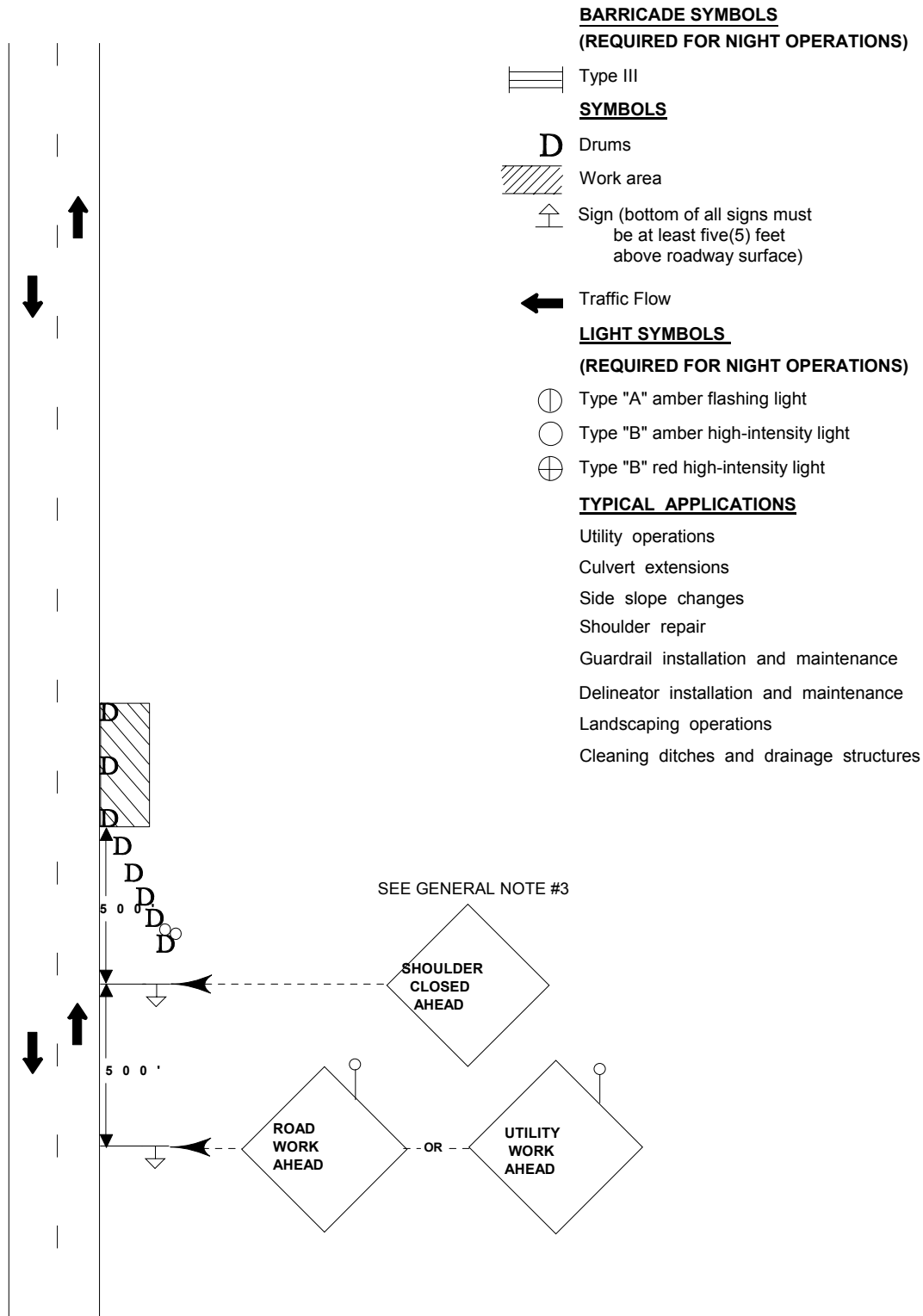
TWO-LANE, TWO-WAY TRAFFIC, DAY OR NIGHT OPERATIONS OVER 6 FEET FROM EDGE OF PAVEMENT

Where, at all times, all vehicles, equipment, workers and their activities are more than the width of the shoulder, but not less than six (6) feet from the edge of the pavement.

General Notes

1. No special signing is required.
2. If the work operation requires that two (2) or more vehicles cross the shoulder or six (6) foot clear zone in any one hour, traffic control will be in conformance with Case 2.
3. All vehicles in a work area shall display flashing lights installed for the purpose of warning approaching drivers of a vehicular traffic hazard requiring unusual care in approaching, overtaking, or passing.
4. This Case 1 is a minimum requirement for the condition set forth. The Traffic Engineer may require additional traffic control devices including flaggers as deemed necessary.

STANDARD DESIGN
TYPICAL APPLICATION OF TRAFFIC CONTROL DEVICES FOR
HIGHWAY CONSTRUCTION, MAINTENANCE AND UTILITY OPERATIONS
CASE 2
TWO-LANE, TWO-WAY TRAFFIC - DAY OR NIGHT OPERATIONS
SHOULDER CLOSURE



CASE 2

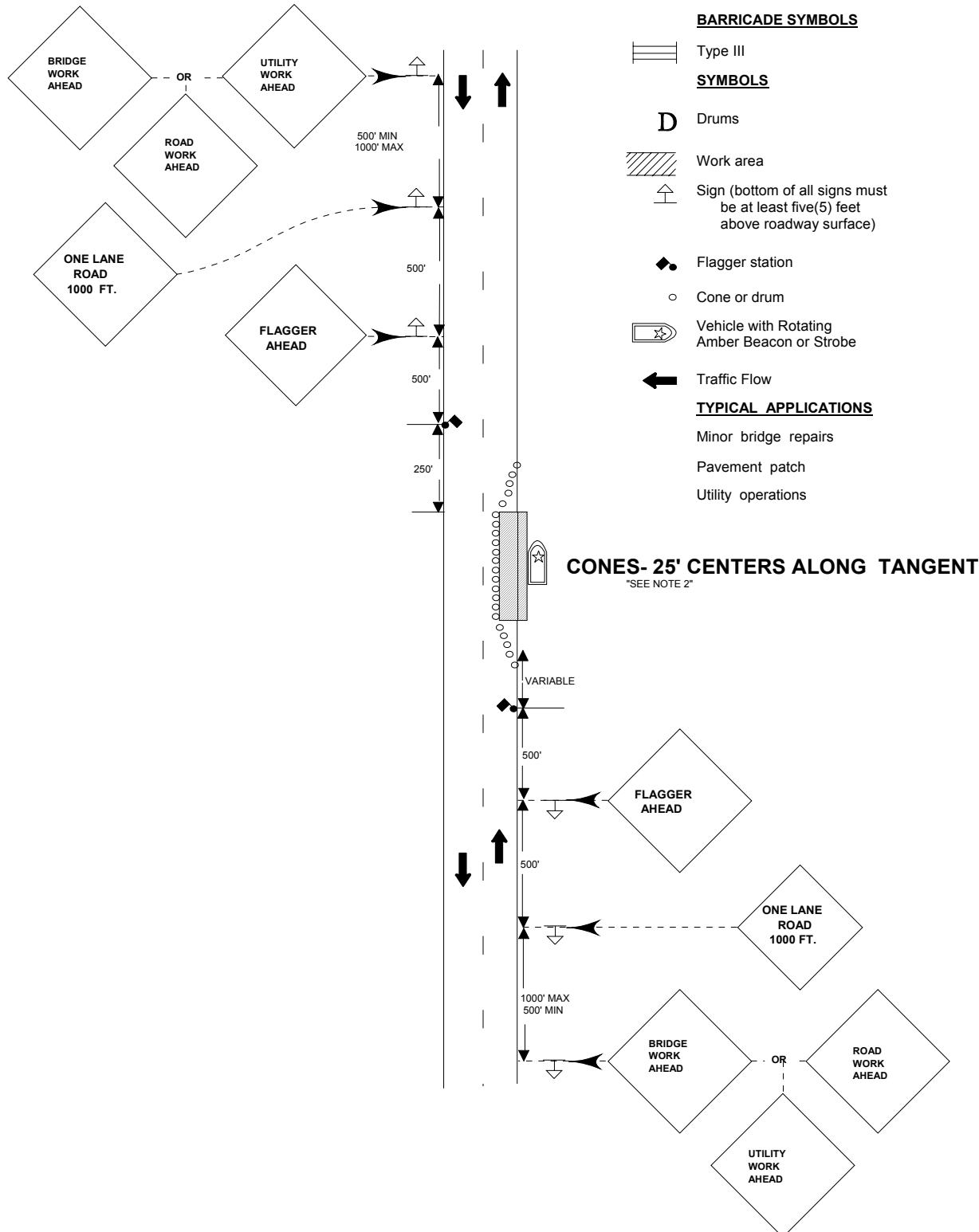
TWO-LANE, TWO-WAY TRAFFIC, DAY OR NIGHT OPERATIONS SHOULDER CLOSED

Where, at all times, all vehicles, equipment, workers and their activities are less than the width of the shoulder, or less than six (6) feet from the edge of, but not encroaching on the travelway.

General Notes

1. All vehicles, equipment, workers (except flagger) and their activities are restricted at all times to one side of the pavement, unless otherwise authorized by the Traffic Engineer.
2. If the work operation requires that four (4) or more vehicles enter the through traffic lane in a one (1) hour period, a flagger shall be provided and the Flagger Ahead sign shall be substituted for the WORKER sign.
3. Any unattended obstacle or excavation in the work area shall be protected by Drums.
4. A minimum of two (2) AMBER TYPE "B" high intensity flashing warning lights shall be used at night in advance of the work area. One AMBER flashing light shall be installed above each of the first two (2) advance warning signs in the series. At night two (2) TYPE "B" lights shall be used on the Drum(s) across the approach to the work area. Drums placed along the side of the work area adjacent and perpendicular to the lane open to traffic. The Drums shall be not more than 100 ft. apart on tangent sections and 50 ft. apart on curve sections. Every tangent section 15 feet or longer shall have at least three (3) Drums.
5. Longitudinal dimensions may be adjusted slightly to fit field conditions.
6. All vehicles in a work area shall display flashing lights installed for the purpose of warning approaching drivers of a vehicular traffic hazard requiring unusual care in approaching, overtaking, or passing.
7. Signs will be displayed in both directions if a flagger is on duty.
8. This is the minimum requirement for the condition set forth. The Traffic Engineer may require additional traffic control devices as deemed necessary.
9. Cones may be used in lieu of drums during daylight operations. Reflectorized cones may be used in lieu of drums for a single night operation (emergency work) that is continuously manned.

STANDARD DESIGN
TYPICAL APPLICATION OF TRAFFIC CONTROL DEVICES FOR
HIGHWAY CONSTRUCTION, MAINTENANCE AND UTILITY OPERATIONS
CASE 3
TWO-LANE, TWO-WAY TRAFFIC - DAY OPERATIONS ONLY
LANE CLOSURE



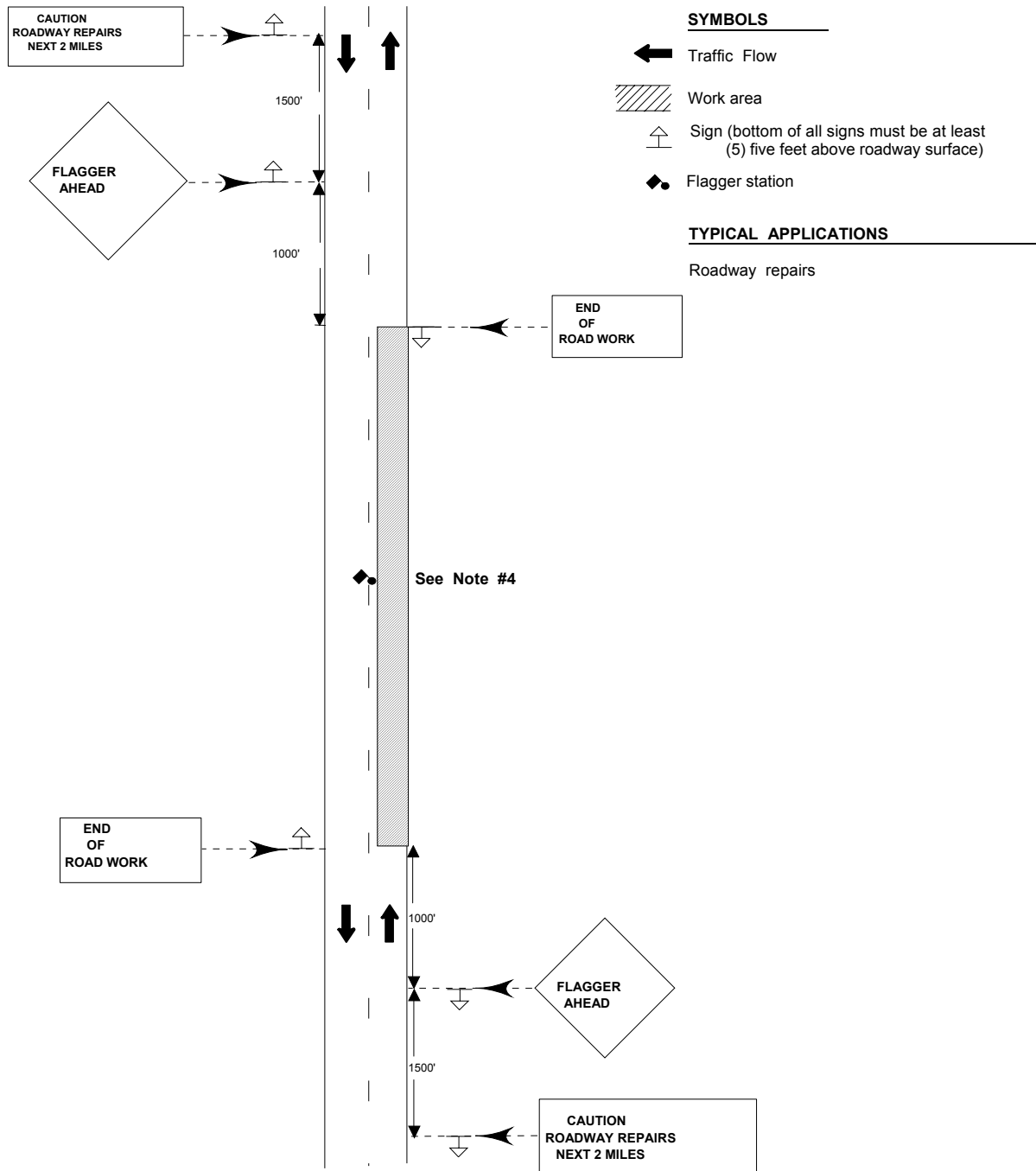
CASE 3
TWO-LANE, TWO-WAY TRAFFIC, DAY OPERATIONS ONLY
LANE CLOSURE

Where, at any time, any vehicle, equipment, workers or their activities will encroach in the area between the centerline and the outside edge of the roadway or pavement.

General Notes

1. All vehicles, equipment, workers (except flagger) and their activities are restricted at all times to one side of the pavement, unless otherwise authorized by the Traffic Engineer.
2. Construction, utility or maintenance operations shall be confined to one (1) traffic lane, leaving the opposite lane open to traffic. At least 500 feet of both traffic lanes shall be available for traffic movement at intervals not greater than 1,000 feet. A complete traffic control plan must be approved for any project expected to exceed 1,000 feet in length including both taper and work areas.
3. If the work operation does not exceed one (1) hour, traffic control will be in conformance with Case 7-A.
4. The flagger shall be in sight of each other or in communications at all times.
5. When traffic volumes permit or there is no work being performed, the FLAGGER AHEAD signs and the flagger will not be required, except as directed by the Engineer. ONE LANE ROAD 500 FEET signs shall be installed in place of FLAGGER signs.
6. All signs are to be removed at completion of the day's operations.
7. When a side road intersects the highway on which work is being performed, additional traffic control devices shall be erected as directed by the Traffic Engineer.
8. Longitudinal dimensions may be adjusted slightly to fit field conditions.
9. All vehicles in a work area shall display flashing lights installed for the purpose of warning approaching drivers of a vehicular traffic hazard requiring unusual care in approaching, overtaking, or, passing.
10. This is the minimum requirement for the condition set forth. The Traffic Engineer may require additional traffic control devices as deemed necessary.

STANDARD DESIGN
TYPICAL APPLICATION OF TRAFFIC CONTROL DEVICES FOR
HIGHWAY CONSTRUCTION, MAINTENANCE AND UTILITY OPERATIONS
CASE 3 - A
TWO-LANE, TWO-WAY, TRAFFIC - MOVING DAYTIME OPERATION



CASE 3-A

TWO-LANE, TWO-WAY TRAFFIC MOVING DAYTIME OPERATION

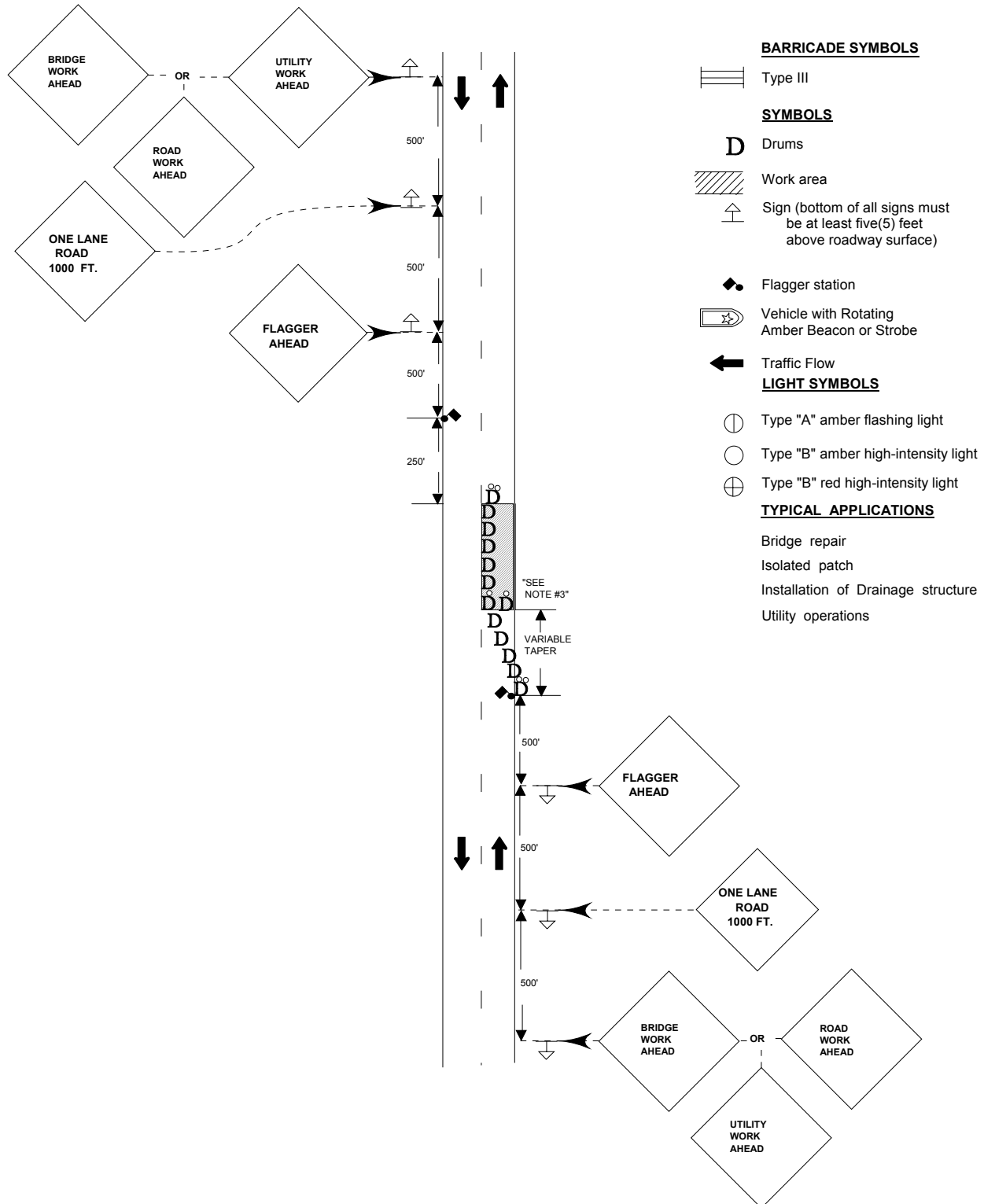
Where, at anytime, any vehicle, equipment, workers or their activities require an intermittent or continuous moving operation which requires a substantial interference with or the closing of one travel lane.

General Notes

1. 1500 feet prior to start of work area signs 48"x 72" will be placed stating: CAUTION ROADWAY REPAIRS NEXT 2 MILES.
2. 1000 feet prior to start of work area, a sign 48"x 48" will be placed stating: FLAGGER AHEAD.
3. Not less than 200 feet nor more than 500 feet would be a truck with an approved arrow panel which would be set to flash in the "WARNING MODE". This vehicle would follow the pothole patching operation maintaining the distances given above. When moving from one location to another, all vehicles will travel on shoulder whenever possible. During patching operation, the above stated vehicle would be positioned in the lane closed to thru traffic.
4. A FLAGGER will be stationed at or near the work site to move traffic safely and expeditiously through or around the work operation.
5. All personnel working in or near the roadway must wear "orange" vests and protective headgear to identify them as being part of a "construction, maintenance or utility work force". FLAGGER must adhere to the standard FLAGGER procedures.
6. When moving from one location to another, all vehicles will travel on shoulder whenever possible.
7. Workers and equipment are confined to one (1) lane leaving adjacent lane open to traffic unless traffic is stopped by flagging.
8. The work area shall not exceed two (2) miles or one-half (1/2) day's operation, whichever is less.
9. When a side road intersects the highway on which work is being performed, additional traffic control devices are required.
10. All vehicles in a work area shall display flashing lights installed for the purpose of warning approaching drivers of a vehicular traffic hazard requiring unusual care in approaching overtaking, or passing.
11. This is the minimum requirement for the condition set forth. The Traffic Engineer may require additional traffic control devices as deemed necessary.

STANDARD DESIGN
TYPICAL APPLICATION OF TRAFFIC CONTROL DEVICES FOR
HIGHWAY CONSTRUCTION, MAINTENANCE AND UTILITY OPERATIONS

CASE 4
TWO-LANE, TWO-WAY TRAFFIC, DAY OR NIGHT
OPERATIONS EXCEEDING ONE DAYLIGHT PERIOD



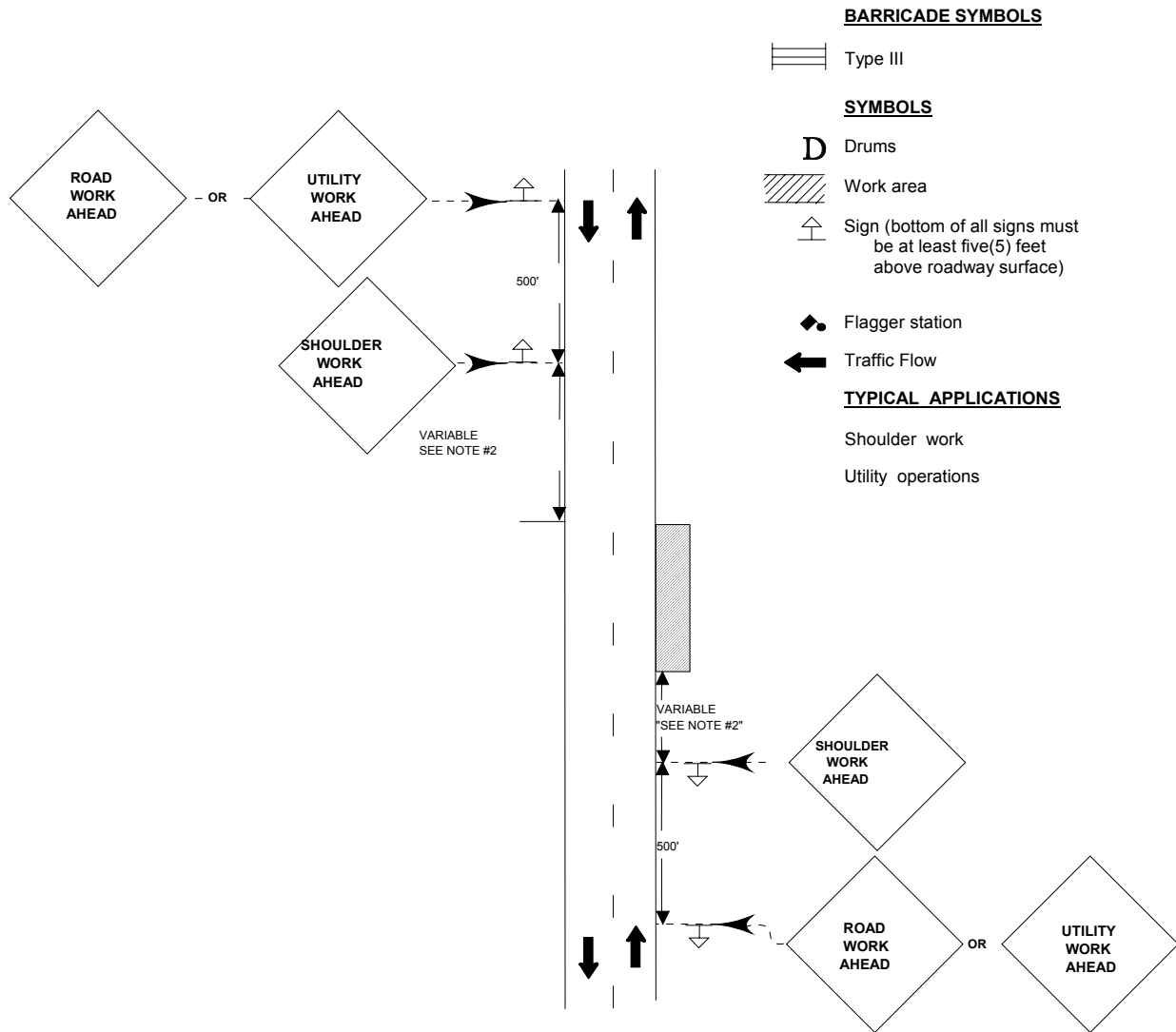
CASE 4

TWO-LANE, TWO-WAY TRAFFIC, DAY OR NIGHT OPERATIONS OR OPERATIONS EXCEEDING ONE DAYLIGHT PERIOD

General Notes

1. All vehicles, equipment, workers (except FLAGGER) and their activities are restricted at all times to one side of the pavement, unless otherwise authorized by the Traffic Engineer.
2. Construction, maintenance or utility operations shall be confined to one (1) traffic lane, leaving the opposite lane open to traffic. At least 500 feet of both traffic lanes shall be available for traffic movement at intervals not greater than 1,000 feet. A complete traffic control plan must be approved for any project expected to exceed 1,000 feet in length including both taper and work areas.
3. The FLAGGER shall be in sight of each other or in communications at all times.
4. When traffic volumes permit, the FLAGGER AHEAD signs and the FLAGGER will not be required, except as directed by the Traffic Engineer. ONE LANE ROAD 500 FEET signs shall be installed in place of FLAGGER AHEAD signs.
5. At FLAGGER station in closed lane, a "Yield To Opposing Traffic" sign must be erected.
6. Drums shall be equipped with one(1) amber Type "B" flashing lights at the point of hazard. One(1) amber Type "B" flashing lights shall be used on the first drum in the series for delineation. This note does not apply during daylight hours. A minimum of one(1) Amber Type "B" flashing lights shall be used at night on each approach in advance the work area. One (1) amber light shall be installed above each of the first two warning signs in the series.
7. All signs shall be post mounted if closure time exceeds four (4) days, unless otherwise authorized by the Traffic Engineer.
8. When a side road intersects the highway on which work is being performed additional traffic control devices shall be erected as directed by the Traffic Engineer.
9. Longitudinal dimensions may be adjusted slightly to fit field conditions.
10. All vehicles in a work area shall display flashing lights installed for the purpose of warning approaching drivers of a vehicular traffic hazard requiring unusual care in approaching overtaking, or passing.
11. This is the minimum requirement for the condition set forth. The Traffic Engineer may require additional traffic control devices as deemed necessary.

STANDARD DESIGN
TYPICAL APPLICATION OF TRAFFIC CONTROL DEVICES FOR
HIGHWAY CONSTRUCTION, MAINTENANCE AND UTILITY OPERATIONS
CASE 5
TWO-LANE, TWO-WAY, SHOULDER MOVING DAYTIME OPERATIONS



CASE 5

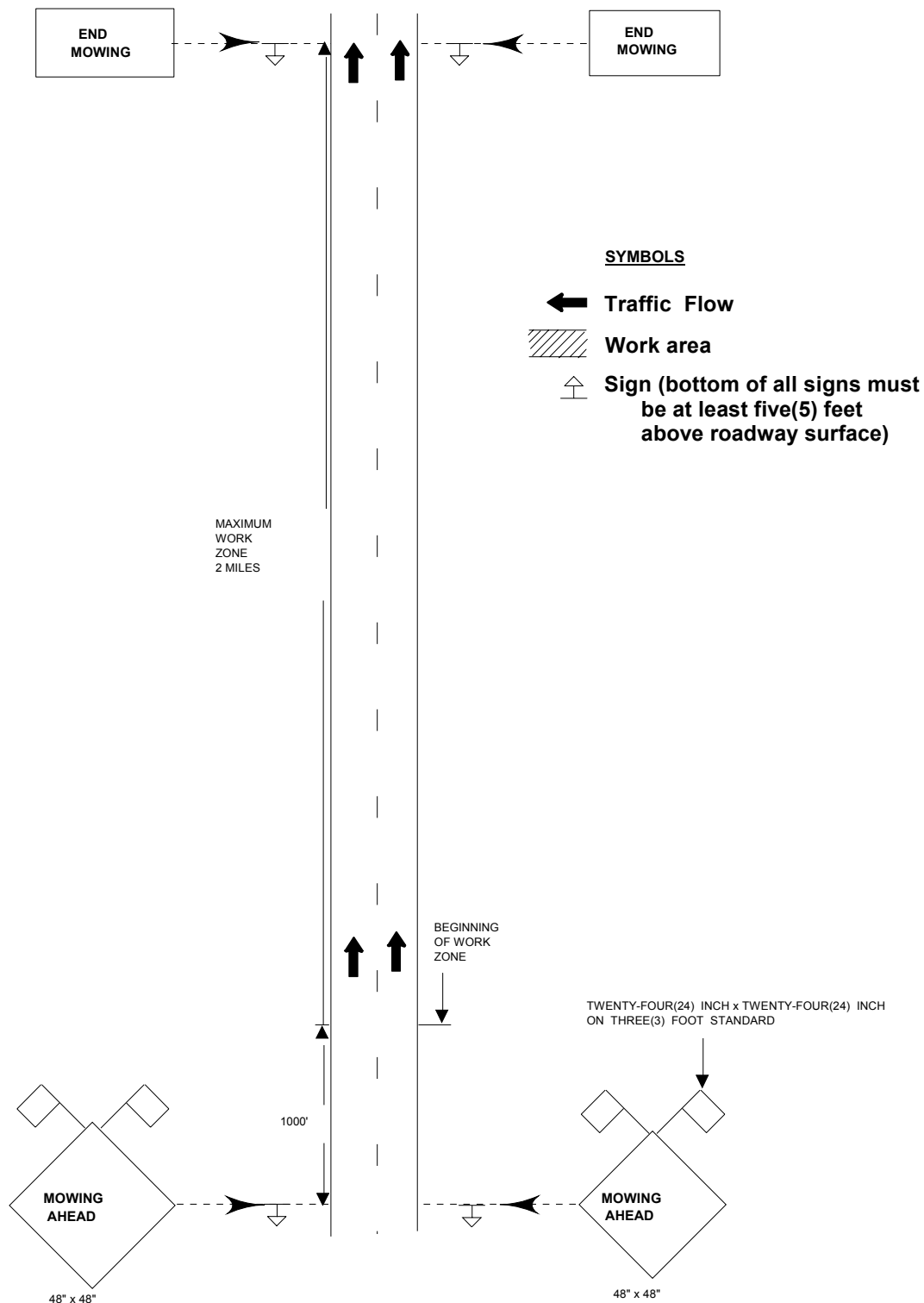
TWO-LANE, TWO-WAY, SHOULDER MOVING DAYTIME OPERATIONS

Where, at any time, any vehicle, equipment, workers or their activities require an intermittent or continuous moving operation on the shoulder or in median.

General Notes

1. All vehicles, equipment, workers (except flagger) and their activities are restricted at all times to one side of the pavement, unless otherwise authorized by the Traffic Engineer.
2. Minimum distance is 200 feet, maximum distance to be determined by the Traffic Engineer, but in no case to exceed the length of one-half (1/2) day's operation or two (2) miles, whichever is less.
3. If the work operation does not exceed one (1) hour, traffic control will be in conformance with Case 7-A.
4. For divided highways, the required advance warning signs shall be posted on both the right and left side of the roadway and all signs for traffic approaching from the opposite direction will be omitted.
5. If the work operation requires that four (4) or more vehicles enter through traffic lanes in a one (1) hour period, a flagman shall be provided and the Flagger Ahead sign(s) shall be substituted for the Workers sign(s).
6. Any unattended obstacle or excavation in the work area shall be protected by Drums, with two (2) AMBER TYPE "A" flashing lights at night.
7. All signs are to be removed at the completion of the day's operations.
8. All vehicles in a work area shall display flashing lights installed for the purpose of warning approaching drivers of a vehicular traffic hazard requiring unusual care in approaching, overtaking, or passing.
9. Longitudinal dimensions may be adjusted slightly to fit field conditions.
10. This is the minimum requirement for the condition set forth. The Traffic Engineer may require additional traffic control devices as deemed necessary.

STANDARD DESIGN
TYPICAL APPLICATION OF TRAFFIC CONTROL DEVICES FOR
HIGHWAY CONSTRUCTION, MAINTENANCE AND UTILITY OPERATIONS
CASE 5-A
TWO-LANE, ONE-WAY, TRAFFIC - MOWING DAYTIME OPERATION



CASE 5-A

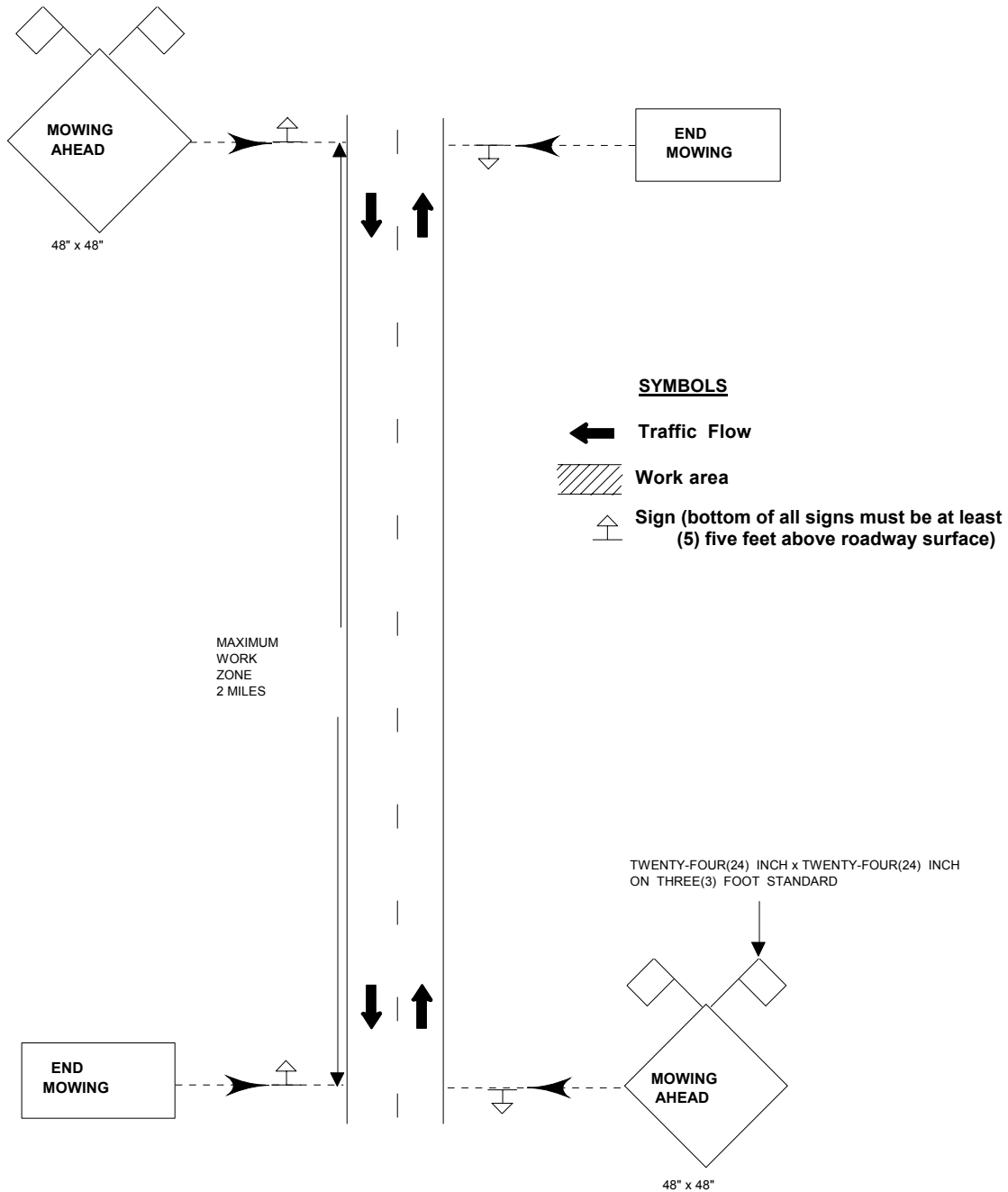
TWO-LANE ONE WAY TRAFFIC MOWING DAYTIME OPERATION

Where at any time vehicle, equipment, workers or their activities require an intermittent, or continuous mowing operation on the shoulder or in median.

General Notes

1. All vehicles, equipment, workers and their activities are restricted at all times to one side of the pavement, unless otherwise authorized by the Traffic Engineer.
2. Minimum distance is 200 feet, maximum distance to be determined by the Traffic Engineer, but in no case to exceed the length of one-half (1/2) days operation or two (2) miles whichever is less.
3. For divided highway the required advance warning signs shall be posted on both the right and left sides of the roadway and all signs for traffic approaching from the opposite direction will be omitted.
4. All signs are to be removed at the completion of the days operation.
5. All vehicles in a work area shall display flashing lights installed for the purpose of warning approaching drivers of a vehicular traffic hazard requiring unusual care in approaching, overtaking, or passing.
6. Longitudinal dimensions may be adjusted to fit field conditions.
7. This is the minimum requirements for the conditions set forth. The Traffic Engineer may require additional traffic control devices as deemed necessary.

STANDARD DESIGN
TYPICAL APPLICATION OF TRAFFIC CONTROL DEVICES FOR
HIGHWAY CONSTRUCTION, MAINTENANCE AND UTILITY OPERATIONS
CASE 5-B
TWO-LANE, TWO-WAY TRAFFIC - MOWING DAYTIME OPERATION



CASE 5-B

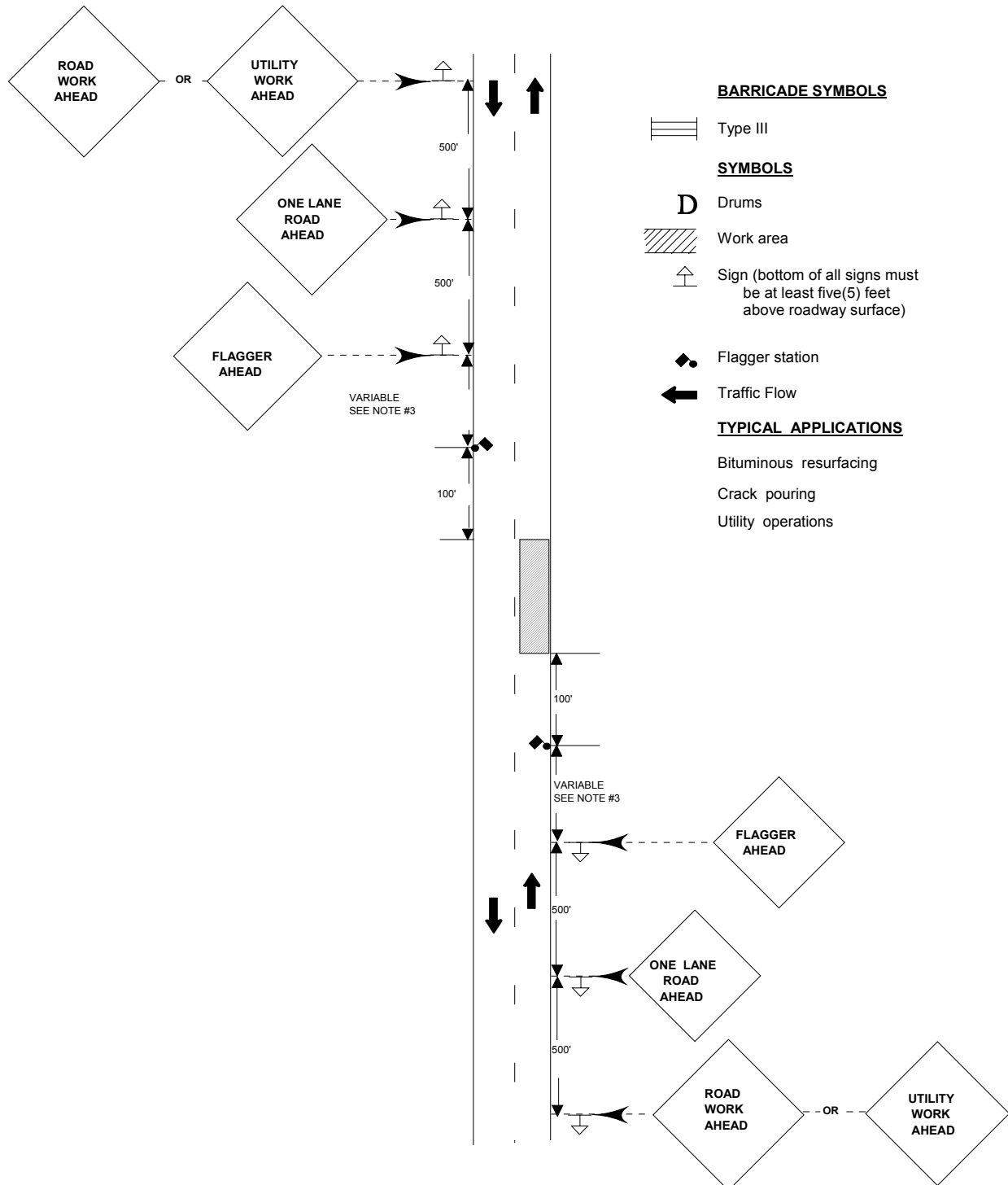
TWO-LANE TWO-WAY TRAFFIC MOWING DAYTIME OPERATION

Where at any time vehicle, equipment, workers or their activities require an intermittent, or continuous mowing operation on the shoulder or in median.

General Notes

1. All vehicles, equipment, workers and their activities are restricted at all times to one side of the pavement unless otherwise authorized by the Traffic Engineer.
2. Minimum distance is 200 feet, maximum distance to be determined by the Traffic Engineer, but in no case to exceed the length of one-half (1/2) day's operation or two (2) miles whichever is less.
3. For divided highways the required advance warning signs shall be posted on both the right and left side of the roadway and all signs for traffic approaching from the opposite direction will be omitted.
4. All signs are to be removed at the completion of the day's operation.
5. All vehicles in a work area shall display flashing lights installed for the purpose of warning approaching drivers of a vehicular traffic hazard requiring unusual care in approaching, overtaking, or passing.
6. Longitudinal dimensions may be adjusted to fit field conditions.
7. This is the minimum requirements for the conditions set forth. The Traffic Engineer may require additional traffic control devices as deemed necessary.

STANDARD DESIGN
TYPICAL APPLICATION OF TRAFFIC CONTROL DEVICES FOR
HIGHWAY CONSTRUCTION, MAINTENANCE AND UTILITY OPERATIONS
CASE 6
TWO-LANE, TWO-WAY, MOVING DAYTIME OPERATIONS - LANE CLOSURE



CASE 6

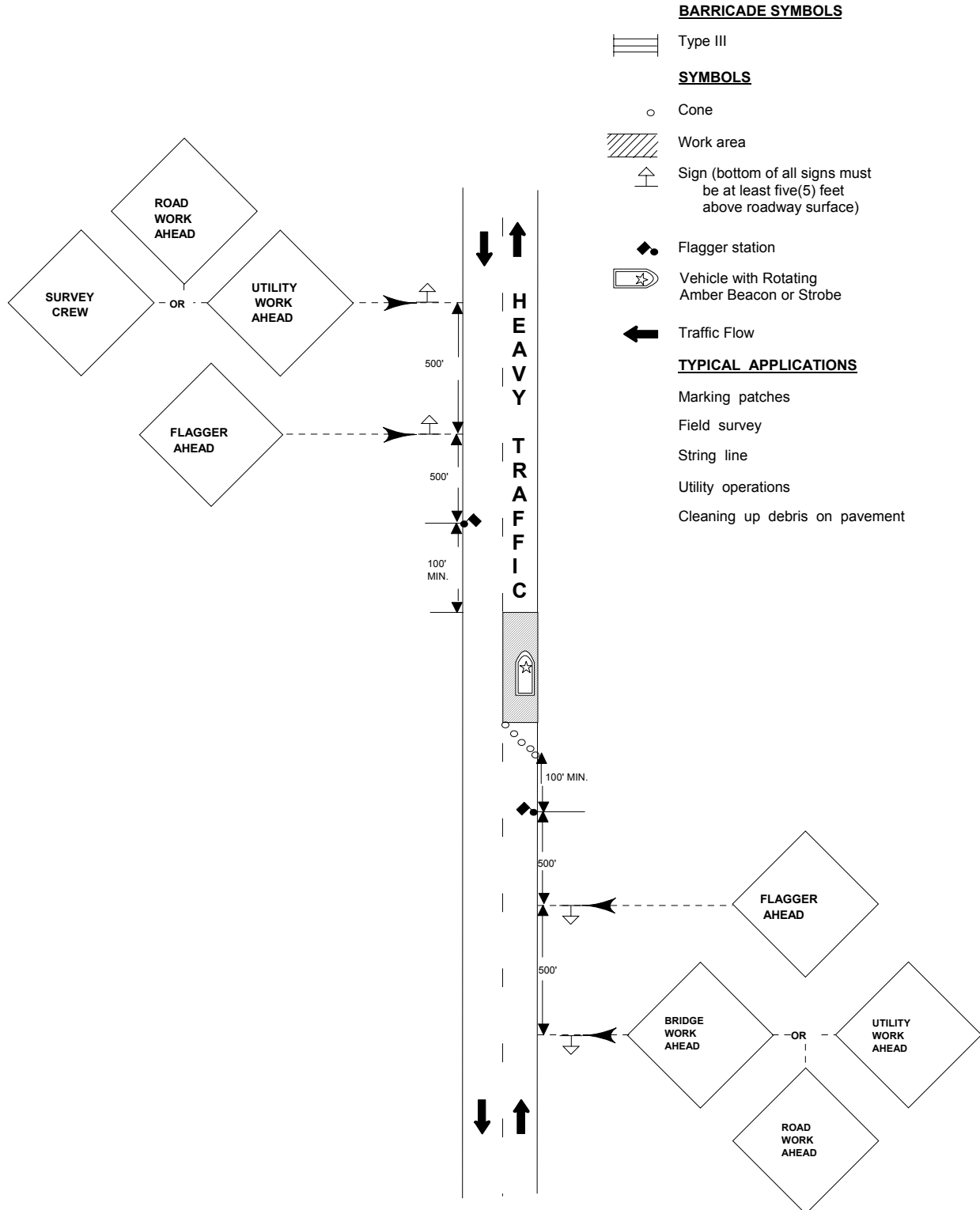
TWO-LANE, TWO-WAY, MOVING DAYTIME OPERATIONS - LANE CLOSURE

Where, at anytime, any vehicle, equipment, workers or their activities require an intermittent or continuous moving operation on the roadway or pavement where the average speed is less than four (4) miles per hour.

General Notes

1. All vehicles, equipment, workers (except flagger) and their activities are restricted at all times to one side of the pavement, unless otherwise authorized by the Engineer.
2. Construction or maintenance operations shall be confined to one traffic lane, leaving the opposite lane open to traffic. At least 500 feet of both traffic lanes shall be available for traffic movement at intervals not greater than 1,000 feet. A complete traffic control plan must be approved for any project expected to exceed 1,000 feet in length including both taper and work areas.
3. Minimum distance is 200 feet. Maximum distance to be determined by the Engineer, but in no case to exceed the length of one-half (1/2) day's operation or two (2) miles, whichever is less.
4. If the total work operation does not exceed one (1) hour, traffic control will be in conformance with Case 7-A.
5. The flagger shall be in sight of each other or in communications at all times.
6. All signs are to be removed at completion of the day's operations.
7. Workers signs are to be removed when no work is being performed.
8. Longitudinal dimensions may be adjusted slightly to fit field conditions.
9. All vehicles in a work area shall display flashing lights installed for the purpose of warning approaching drivers of a vehicular traffic hazard requiring unusual care in approaching, overtaking, or passing.
10. This is the minimum requirement for the condition set forth. The Traffic Engineer may require additional traffic control devices as deemed necessary.

STANDARD DESIGN
TYPICAL APPLICATION OF TRAFFIC CONTROL DEVICES FOR
HIGHWAY CONSTRUCTION, MAINTENANCE AND UTILITY OPERATIONS
CASE 7 - A
TWO-LANE, TWO-WAY TRAFFIC
SHORT TIME LANE CLOSURE, DAYTIME ONLY - HEAVY TRAFFIC



CASE 7-A

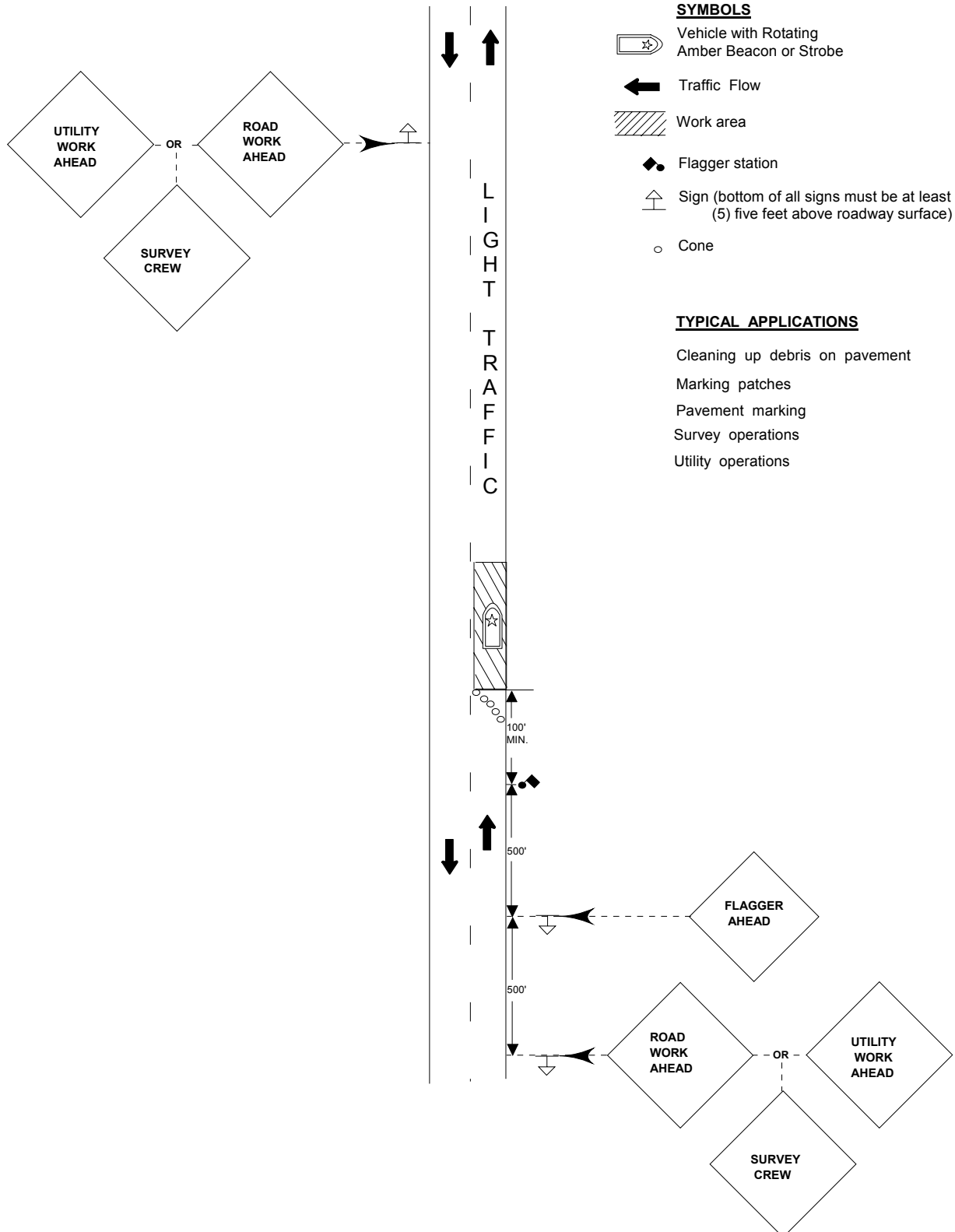
TWO-LANE, TWO-WAY TRAFFIC SHORT TIME LANE CLOSURE DAYTIME ONLY - HEAVY TRAFFIC

For any operation that encroaches in the area between the centerline and the outside edge of the roadway or pavement for a period of less than one (1) hour.

General Notes

1. All vehicles, equipment, workers (except flagger) and their activities are restricted at all times to one side of the pavement unless otherwise authorized by the Engineer.
2. Construction operations shall be confined to one traffic lane, leaving the opposite lane open to traffic. At least 500 feet of both traffic lanes shall be available for traffic movement at intervals not greater than 1,000 feet. A complete traffic control plan must be approved for any project expected to exceed 1,000 feet in length including both taper and work areas.
3. The flagger shall be in sight of each other or in communications at all times.
4. Longitudinal dimensions may be adjusted slightly to fit field conditions.
5. All vehicles in a work area shall display flashing lights installed for the purpose of warning approaching drivers of a vehicular traffic hazard requiring unusual care in approaching, overtaking, or passing.
6. This is the minimum requirement for the condition set forth. The Traffic Engineer may require additional traffic control devices as deemed necessary.

STANDARD DESIGN
TYPICAL APPLICATION OF TRAFFIC CONTROL DEVICES FOR
HIGHWAY CONSTRUCTION, MAINTENANCE AND UTILITY OPERATIONS
CASE 7 - B
TWO-LANE, TWO-WAY TRAFFIC
SHORT TIME LANE CLOSURE, DAYTIME ONLY - LIGHT TRAFFIC



CASE 7-B

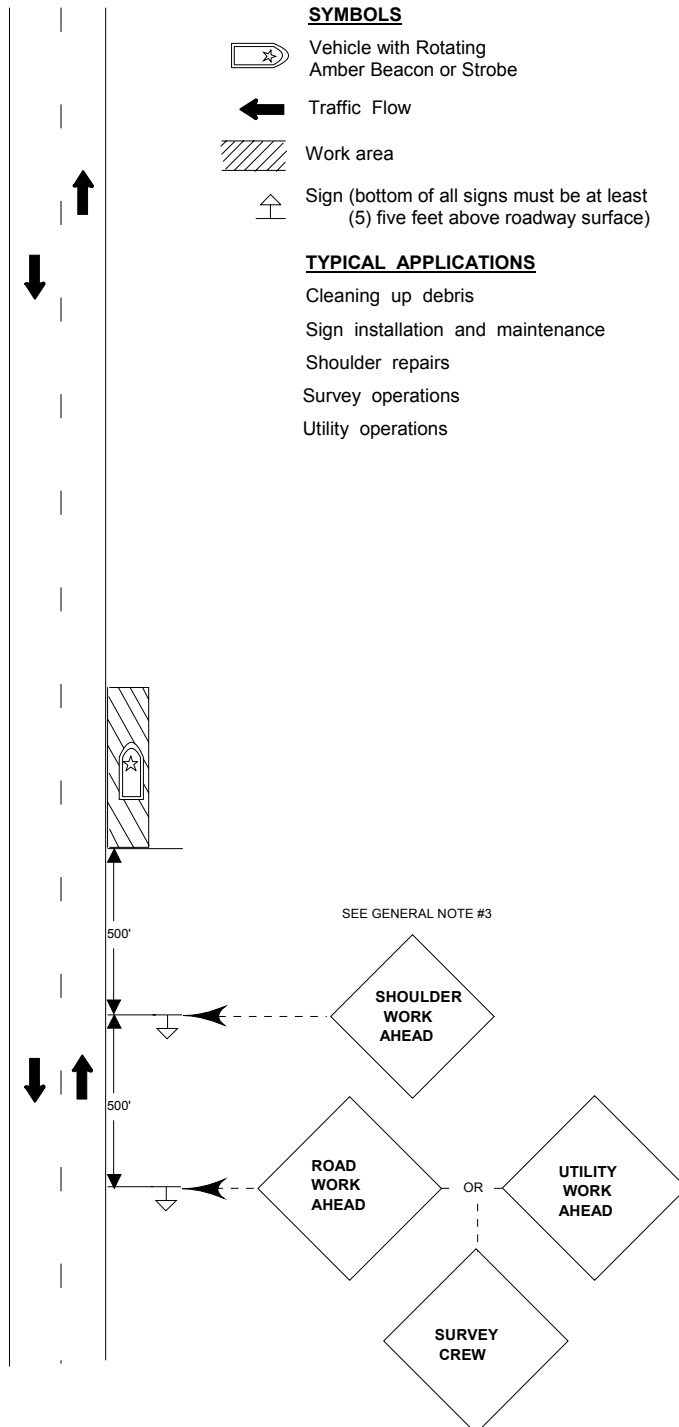
TWO-LANE, TWO-WAY TRAFFIC SHORT TIME LANE CLOSURE DAYTIME ONLY - LIGHT TRAFFIC

For any operations that encroaches in the area between the centerline and outside the edge of the roadway or pavement for a period of less than one (1) hour.

General Notes

1. All vehicles, equipment, workers (except flagger) and their activities are restricted at all times to one side of the pavement unless otherwise authorized by the Engineer.
2. Construction and maintenance operations shall be confined to one traffic lane.
3. When it is necessary to stop traffic in both directions, traffic control will be in conformance with Case 7-A.
4. All signs shall be removed at completion of the day's operations.
5. Longitudinal dimensions may be adjusted slightly to fit field conditions.
6. All vehicles in a work area shall display flashing lights installed for the purpose of warning approaching drivers of a vehicular traffic hazard requiring unusual care in approaching, overtaking, or passing.
7. This is the minimum requirement for the condition set forth. The Traffic Engineer may require additional traffic control devices as deemed necessary.

STANDARD DESIGN
TYPICAL APPLICATION OF TRAFFIC CONTROL DEVICES FOR
HIGHWAY CONSTRUCTION, MAINTENANCE AND UTILITY OPERATIONS
CASE 7 - C
TWO-LANE, TWO-WAY OR MULTILANE TRAFFIC
SHORT TIME SHOULDER CLOSURE - DAYTIME ONLY



CASE 7-C

TWO-LANE, TWO-WAY OR MULTILANE TRAFFIC SHORT TIME SHOULDER CLOSURE DAYTIME ONLY

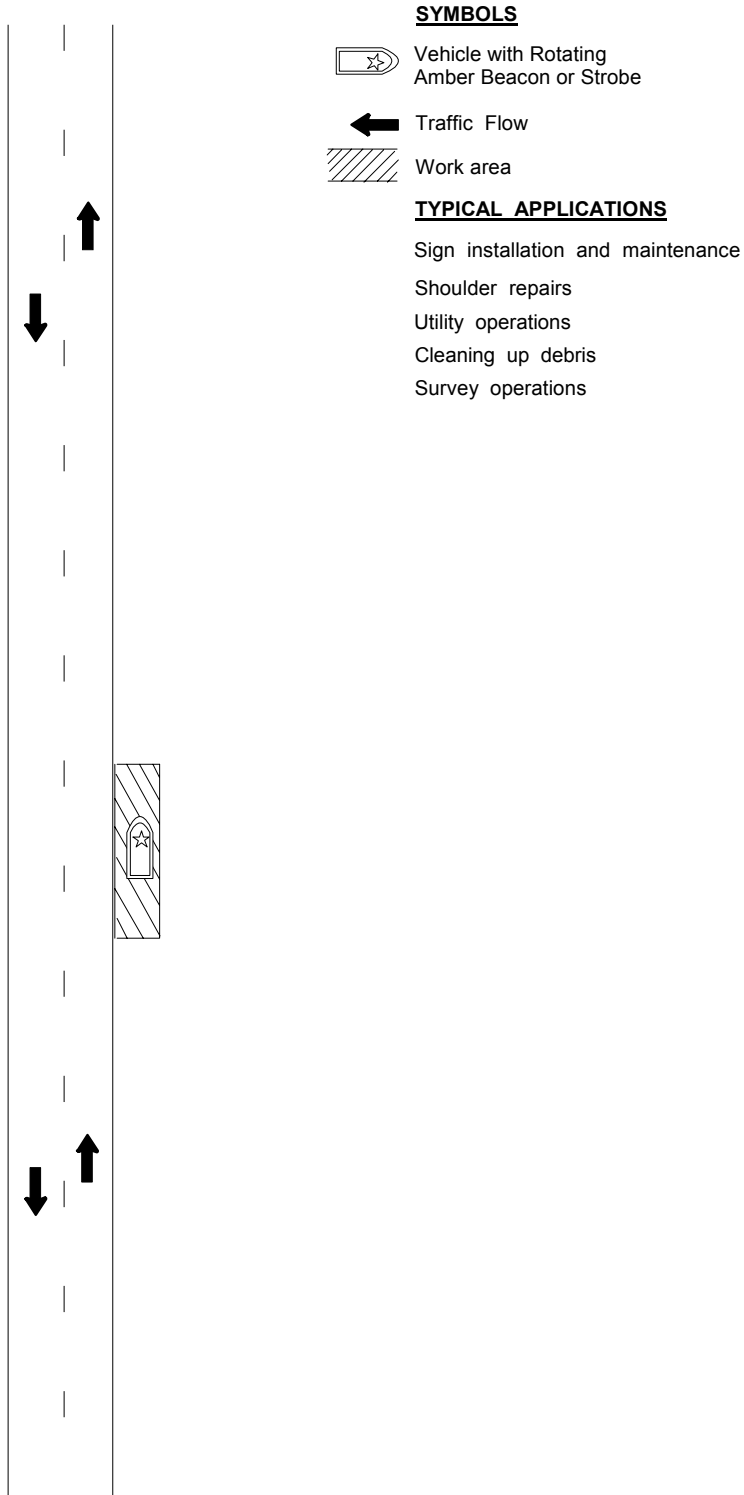
For any operation that is outside the edge of the roadway or pavement for a period of more than twenty (20) minutes, but less than one (1) hour.

General Notes

1. All vehicles, equipment, workers (except flagger) and their activities are restricted at all times to one side of the pavement unless otherwise authorized by the Engineer.
2. Construction and maintenance operations shall be confined to the area outside of the edge of pavement.
3. When workers or vehicles encroach on the travelway, traffic control shall be in conformance with Case 7-B.
4. All signs shall be removed at completion of day's operations.
5. Longitudinal dimensions may be adjusted slightly to fit field conditions.
6. All vehicles in a work area shall display flashing lights installed for the purpose warning approaching drivers of a vehicular traffic hazard requiring unusual care in approaching, overtaking, or passing.
7. This is the minimum requirement for the condition set forth. the Traffic Engineer may require additional traffic control devices as deemed necessary.

**STANDARD DESIGN
TYPICAL APPLICATION OF TRAFFIC CONTROL DEVICES FOR
HIGHWAY CONSTRUCTION, MAINTENANCE AND UTILITY OPERATIONS
CASE 7 - D**

**TWO-LANE, TWO-WAY OR MULTILANE TRAFFIC
SHORT TIME SHOULDER CLOSURE - DAYTIME ONLY (LESS THAN 20 MINUTES)**



CASE 7-D

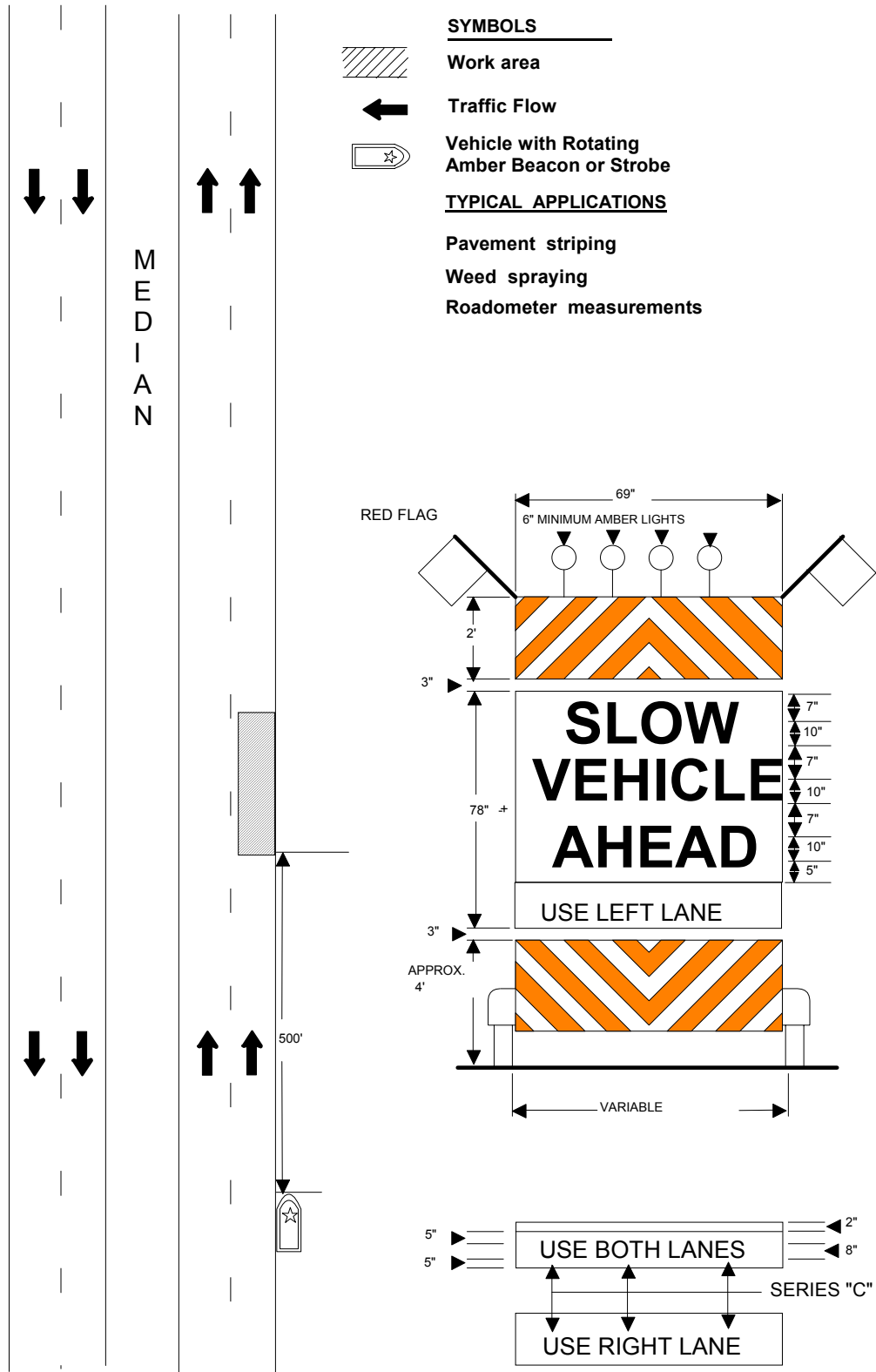
TWO-LANE, TWO-WAY OR MULTILANE TRAFFIC SHORT TIME SHOULDER CLOSURE - DAYTIME ONLY (LESS THAN 20 MINUTES)

For any operation that is outside the edge of the roadway or pavement for a period of less than twenty (20) minutes.

General Notes

1. All vehicles, equipment, workers (except flagger) and their activities are restricted at all times to one side of the pavement unless otherwise authorized by the Engineer.
2. Construction and maintenance operations shall be confined to the area outside of the edge of pavement.
3. When workers or vehicles encroach on the travelway, traffic control shall be in conformance with Case 7-B.
4. All vehicles in a work area shall display flashing lights installed for the purpose of warning approaching drivers of a vehicular traffic hazard requiring unusual care in approaching, overtaking, or passing.
5. This is the minimum requirement for the condition set forth. The Traffic Engineer may require additional traffic control devices as deemed necessary.

STANDARD DESIGN
TYPICAL APPLICATION OF TRAFFIC CONTROL DEVICES FOR
HIGHWAY CONSTRUCTION, MAINTENANCE AND UTILITY OPERATIONS
CASE 8
MOVING OPERATIONS - DAYTIME OPERATIONS ONLY



CASE 8

MOVING OPERATIONS - DAYTIME OPERATIONS ONLY

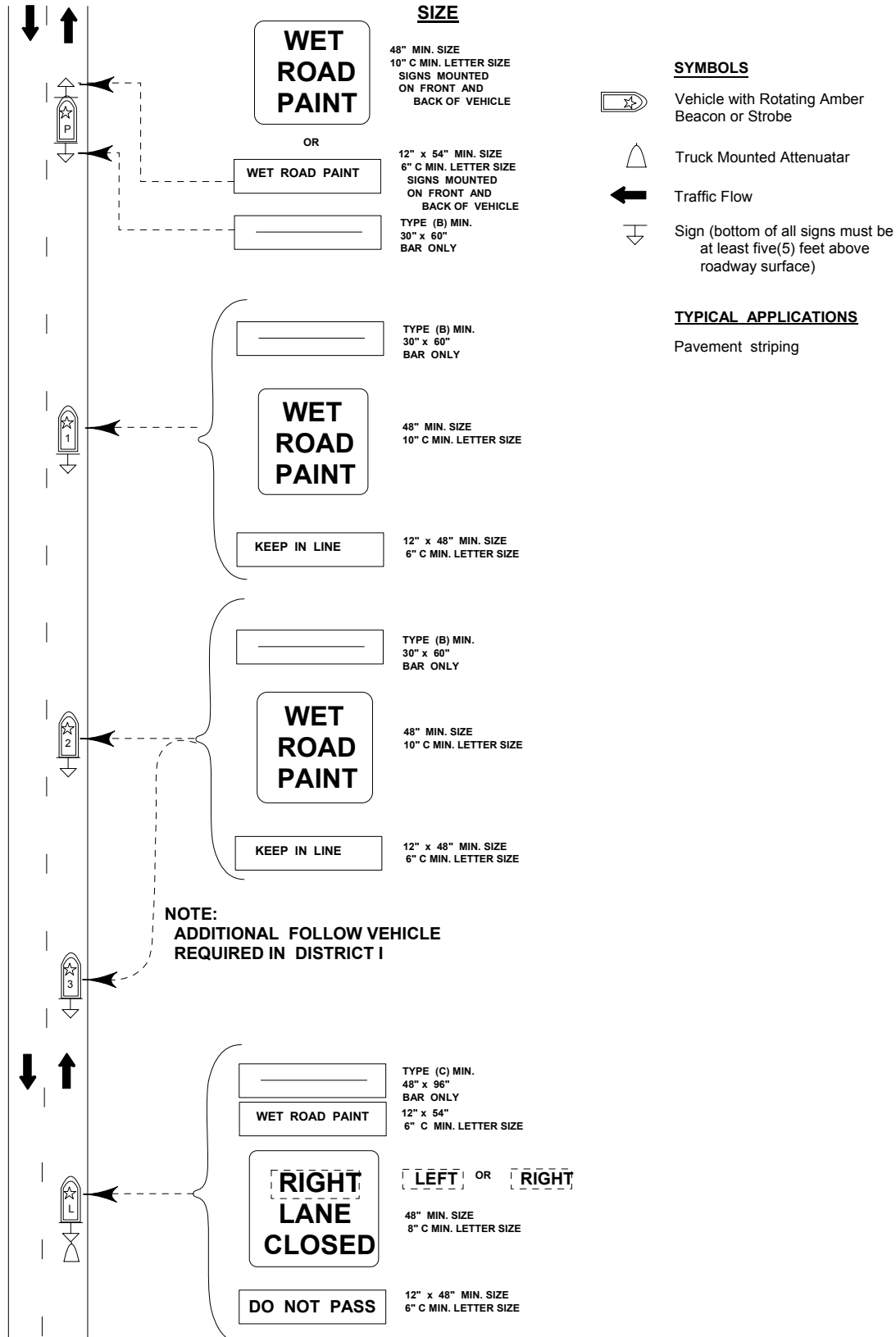
Where, at any time, any vehicle, equipment, workers or their activities require a moving operation where the average speed of movement is greater than four (4) miles per hour, but less than fifteen (15) miles per day.

General Notes

1. All vehicles, equipment, workers (except flagger) and their activities are restricted at all times to one side of the pavement, unless otherwise authorized by the Engineer.
2. If work is being performed in a lane of a divided highway,
 - (a) The protection vehicle shall follow in the closed lane and the sign shall read THIS LANE CLOSED NEXT (?) MILE. The bottom line shall read USE RIGHT OR LEFT LANE.
 - (b) The warning vehicle shall follow on the shoulder or median, and the sign shall read SLOW VEHICLE AHEAD. The bottom line shall read USE RIGHT OR LEFT LANE.
3. If work is being performed in the center lane of the roadway,
 - (a) The protection vehicle shall follow in the closed lane, and the sign shall read THIS LANE CLOSED NEXT (?) MILE. The bottom line shall read USE OPEN LANES.
 - (b) The warning vehicle shall follow on the shoulder, and the sign shall read SLOW VEHICLE AHEAD. The bottom line shall read USE OPEN LANES.
4. If work is being performed on a two-lane, two-way traffic highway,
 - (a) The protection vehicle shall follow in the closed lane, and the sign shall read THIS LANE CLOSED NEXT (?) MILE. The bottom line shall read USE SHOULDER, OR KEEP IN LINE.
 - (b) The warning vehicle shall follow on the shoulder, and the sign should read SLOW VEHICLE AHEAD. The bottom line shall read USE SHOULDER, OR KEEP IN LINE.
5. This case does not apply when work is being performed in the middle lane(s) of a six or more lane highway. Special plans approved by the Engineer will be required.
6. All striping on signs shall have alternating orange and white stripes at 45' from the vertical. All stripes shall be six (6) inches in width.
7. The sign panels shall have the dimensions shown and have black legend on an orange reflectorized background.
8. Where work operations are more than two (2) feet from the edge of the pavement, protection vehicle may be omitted.
9. Pavement striping and cone pickup will be considered as two (2) separate operations.
10. Longitudinal dimensions may be adjusted slightly to fit field conditions.
11. This is the minimum requirement for the condition set forth. The Traffic Engineer may require additional traffic control devices as deemed necessary.

**STANDARD DESIGN
TYPICAL APPLICATION OF TRAFFIC CONTROL DEVICES FOR
HIGHWAY CONSTRUCTION, MAINTENANCE AND UTILITY OPERATIONS
CASE 8 - A**

TWO-LANE, TWO-WAY - MOVING DAYTIME OPERATIONS



CASE 8-A

TWO LANE, TWO Way - MOVING DAYTIME OPERATIONS ONLY

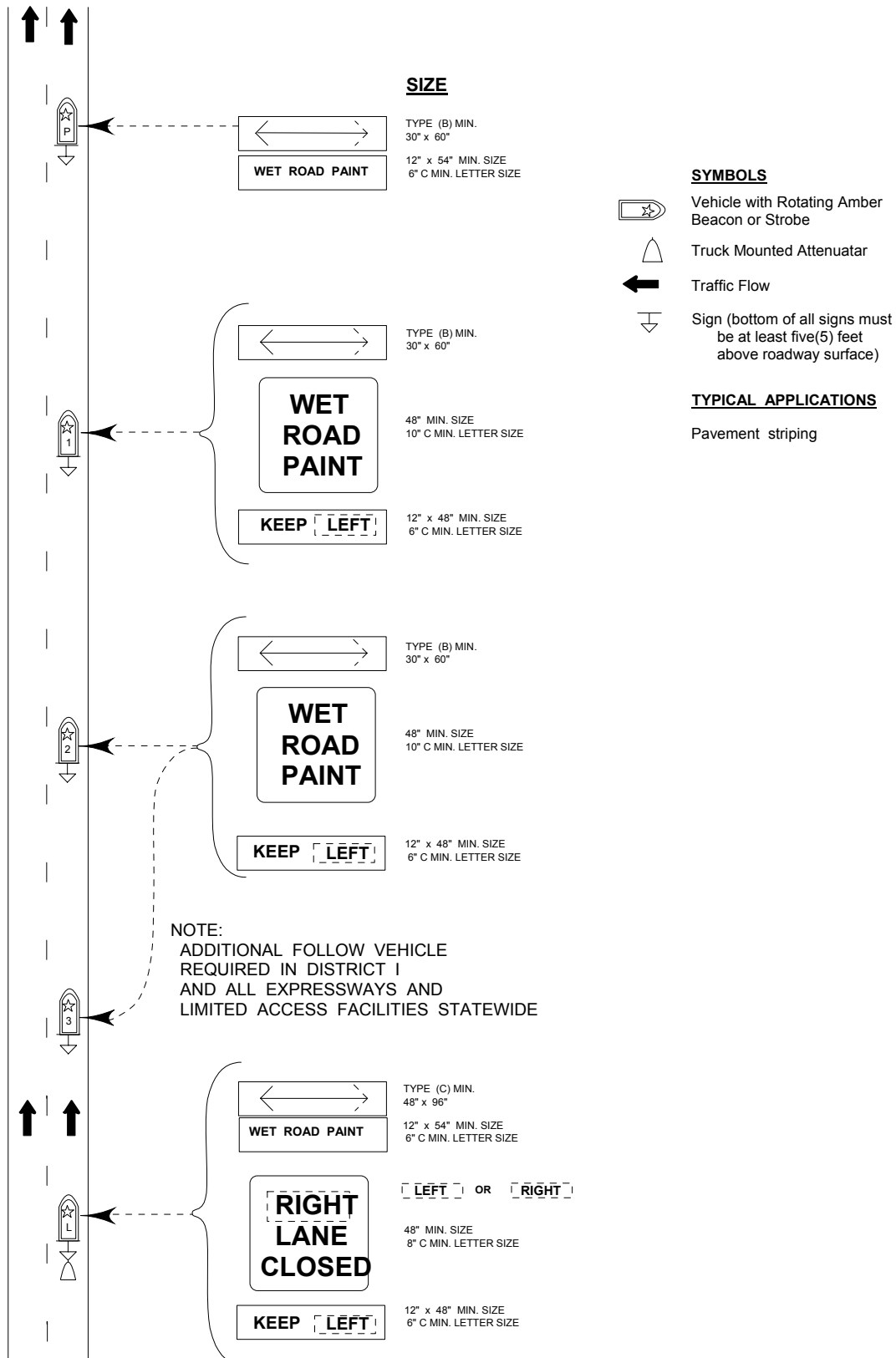
Where, at any time, any vehicle, equipment, workers or their activities require a moving operation where the average speed of movement is greater than four (4) miles per hour, but less than twenty-five (25) miles per hour.

General Notes

1. All vehicles, equipment, workers (except flagger) and their activities are restricted at all times to one side of the pavement, unless otherwise authorized by the Engineer.
2. A minimum of four (4) vehicles are required at all times during moving applications of pavement markings. An additional follow vehicle is required in District I. (*See Standard Design Case 8-A*)
3. The first follow vehicle shall be driven at a variable distance behind the Paint Machine to prevent other vehicles from entering behind the Paint Machine.
The second follow vehicle, the third follow vehicle required in District I and the last follow vehicle shall be driven at intervals of approximately seven hundred and fifty feet (750') behind the first follow vehicle.
The last follow vehicle shall be equipped with an impact attenuator (T.M.A.)
4. Flags and Flashing Lights shall be mounted on the paint gun carriages whenever the carriage is extended 1 foot (1') or more beyond the width of the Paint Machine.
5. All signs must be fabricated of an approved reflective orange background with black copy and white (silver) stripes.
6. Longitudinal dimensions may be adjusted slightly to fit field conditions.
7. This is the minimum requirement for the condition set forth. The Traffic Engineer may require additional traffic control devices as deemed necessary.

STANDARD DESIGN
TYPICAL APPLICATION OF TRAFFIC CONTROL DEVICES FOR
HIGHWAY CONSTRUCTION, MAINTENANCE AND UTILITY OPERATIONS
CASE 8 - B

TWO-LANE, ONE-WAY - MOVING DAYTIME OPERATIONS ONLY



CASE 8-B

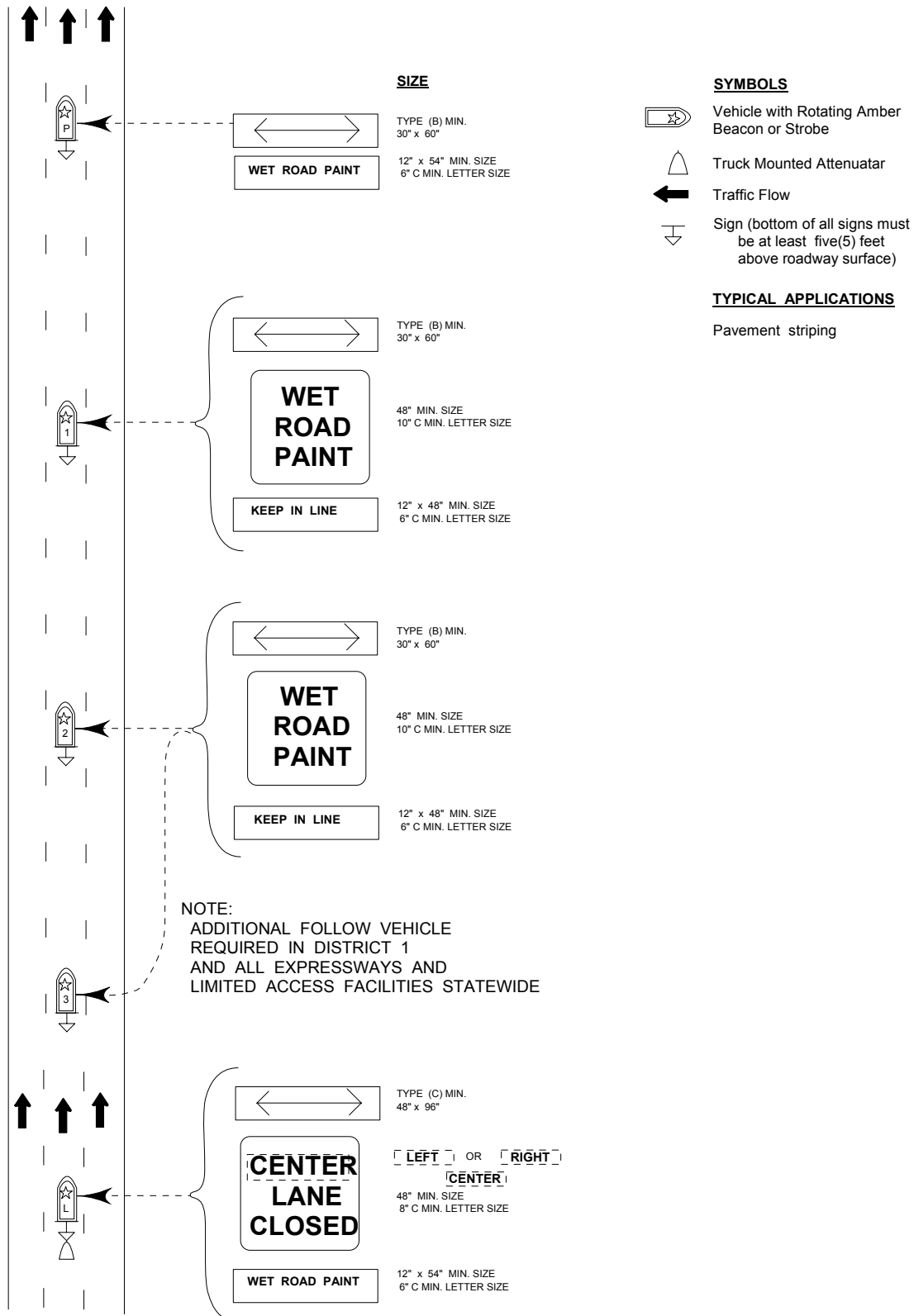
TWO LANE ONE WAY - MOVING DAYTIME OPERATIONS ONLY

Where, at any time, any vehicle, equipment, workers, or their activities require a moving operation where the average speed of movement is greater than four (4) miles per hour, but less than twenty-five (25) miles per hour.

General Notes

1. All vehicles, equipment, workers (except flagger) and their activities are restricted at all times to one side of the pavement, unless otherwise authorized by the Engineer.
2. A minimum of four (4) vehicles are required at all times during moving applications of pavement markings. (*See Standard Design Case 8-B*)
3. If work is being performed in the right lane, the first follow vehicle shall be driven in the right lane at a variable distance behind the Paint Machine to prevent other vehicles from entering behind the Paint Machine.
The second follow vehicle, the third follow vehicle when required and the last follow vehicle shall be driven at intervals of approximately seven hundred and fifty feet (750') behind the first follow vehicle.
The last follow vehicle shall be equipped with an impact attenuator (T.M.A.)
4. If work is being performed in the left lane the above operation would be identical, with the exception that it be performed on the left side of the highway.
5. Flags and flashing lights shall be mounted on the paint gun carriages whenever the carriage is extended 1 foot (1') or more beyond the width of the paint machine.
6. All signs must be fabricated of an approved reflective orange background with black copy and white (silver) stripes.
7. Longitudinal dimensions may be adjusted slightly to fit field conditions.
8. This is the minimum requirement for the condition set forth. The Traffic Engineer may require additional traffic control devices as deemed necessary.

STANDARD DESIGN
TYPICAL APPLICATION OF TRAFFIC CONTROL DEVICES FOR
HIGHWAY CONSTRUCTION, MAINTENANCE AND UTILITY OPERATIONS
CASE 8 - C
MULTILANE, CENTER LANE(S) - MOVING DAYTIME OPERATIONS ONLY



CASE 8-C

MULTI-LANE CENTER LANE(S) - MOVING DAYTIME OPERATIONS ONLY

Where, at any time, any vehicle, equipment, worker or their activities require a moving operation where the average speed of movement is greater than four (4) miles per hour, but less than twenty-five (25) miles per hour.

General Notes

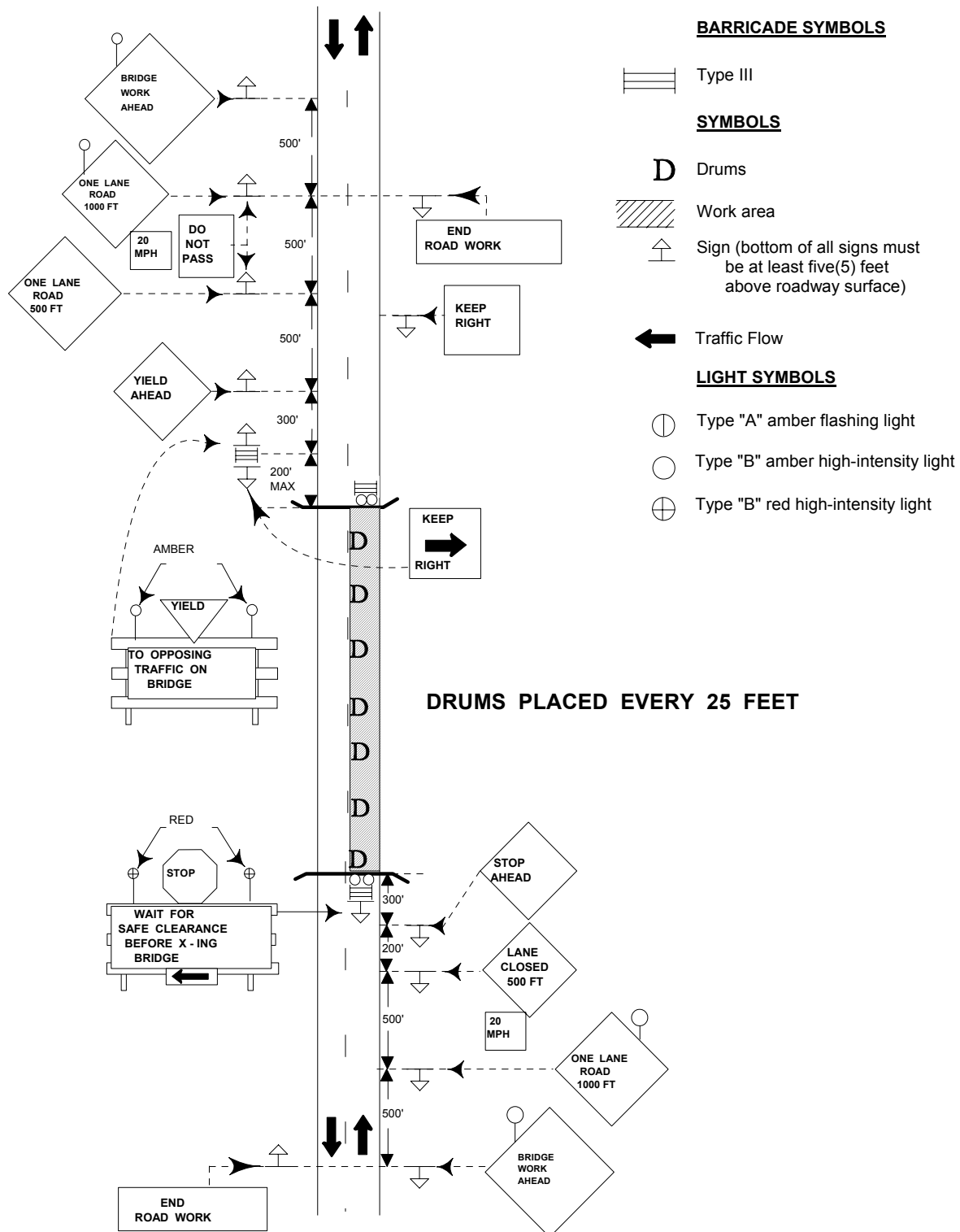
1. All vehicles, equipment, worker (except flagger) and their activities are restricted at all times to one side of the pavement, unless otherwise authorized by the Engineer.
2. A minimum of four (4) vehicles are required at all times during moving applications of pavement markings. (*See Standard Design Case 8-C*)
3. The first follow vehicle shall be driven in the right lane at a variable distance behind the Paint Machine to prevent other vehicles from entering behind the Paint Machine.
The second follow vehicle, the third follow vehicle when required and the last follow vehicle shall be driven at intervals of approximately seven hundred and fifty feet (750') behind the first follow vehicle.
The last follow vehicle shall be equipped with an impact attenuator (T.M.A.)
4. Flags and Flashing Lights shall be mounted on the paint gun carriages whenever the carriage is extended 1 foot (1') or more beyond the width of the Paint Machine.
5. All signs must be fabricated of an approved reflective orange background with black copy and white (silver) stripes.
6. Longitudinal dimensions may be adjusted slightly to fit field conditions.
7. This is the minimum requirement for the conditions set forth. The Traffic Engineer may require additional traffic control devices as deemed necessary.

STANDARD DESIGN
TYPICAL APPLICATION OF TRAFFIC CONTROL DEVICES FOR
HIGHWAY CONSTRUCTION, MAINTENANCE AND UTILITY OPERATIONS

CASE 9

BRIDGE CONSTRUCTION

TWO-LANE, TWO-WAY TRAFFIC, ONE-LANE CLOSURE
ON A BRIDGE DECK - DAY OR NIGHT OPERATIONS



CASE 9

BRIDGE CONSTRUCTION

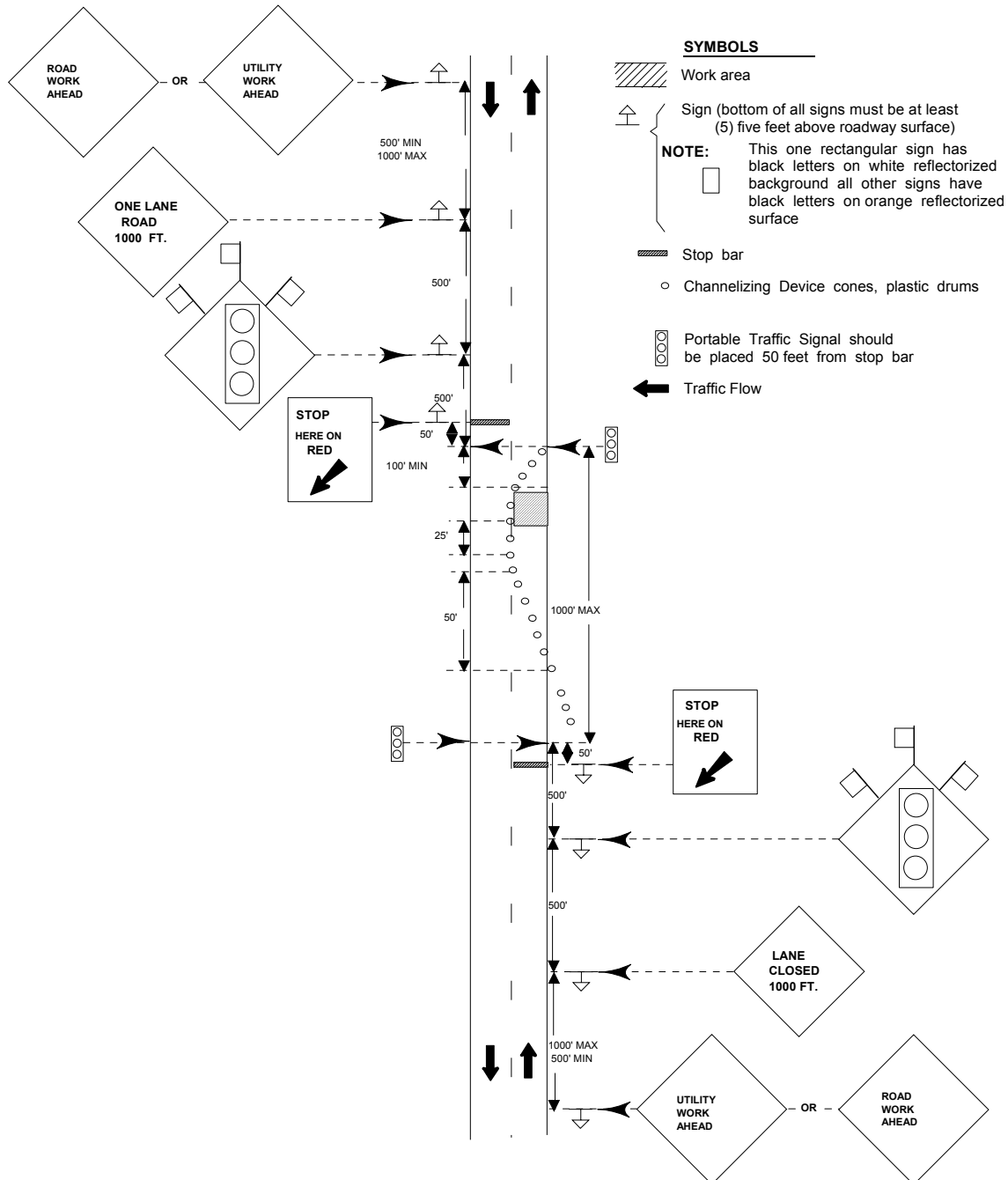
TWO-LANE, TWO-WAY TRAFFIC, ONE-LANE CLOSURE ON A BRIDGE DECK DAY OR NIGHT OPERATIONS

Where, at any time, any vehicle, equipment, workers, or their activities will encroach on one lane of a bridge deck. Approaching vehicles must be able to see each other at all times otherwise use Case 10.

General Notes

1. All vehicles, equipment, workers (except FLAGGER) and their activities are restricted at all times to one side of the pavement, unless otherwise authorized by the Traffic Engineer.
2. Construction, maintenance or utility operations shall be confined to one (1) traffic lane, leaving the opposite lane open to traffic.
3. Advance warning signs and Type III barricades with TYPE B, high-intensity flashing lights shall be used as shown.
4. When a FLAGGER is used, the STOP, STOP AHEAD and YIELD signs shall be covered and the RIGHT AND LEFT LANE CLOSED 500 FEET sign(s) shall be replaced with the FLAGGER 500 FEET sign(s).
5. The FLAGGERS shall be in sight of each other or in direct communications at all times.
6. When no work is being performed and during nighttime, the work area shall be protected with Drums.
7. Signs shall be post mounted if closure time exceeds four (4) days, unless otherwise authorized by the Engineer.
8. Longitudinal dimensions may be adjusted slightly to fit conditions.
9. On a lightly traveled road when authorized by the Engineer, traffic control shall be in conformance with Case 3 or Case 4.
10. All vehicles in a work area shall display flashing lights installed for the purpose of warning approaching drivers of a vehicular traffic hazard requiring unusual care in approaching, overtaking, or passing.
11. This is the minimum requirement for the condition set forth. The Traffic Engineer may require additional traffic control devices as deemed necessary.

STANDARD DESIGN
TYPICAL APPLICATION OF TRAFFIC CONTROL DEVICES FOR
HIGHWAY CONSTRUCTION, MAINTENANCE AND UTILITY OPERATIONS
CASE 10
STATIONARY SHORT-TERM PORTABLE TRAFFIC SIGNAL OPERATION
ON A TWO-LANE TWO-WAY ROADWAY



CASE 10

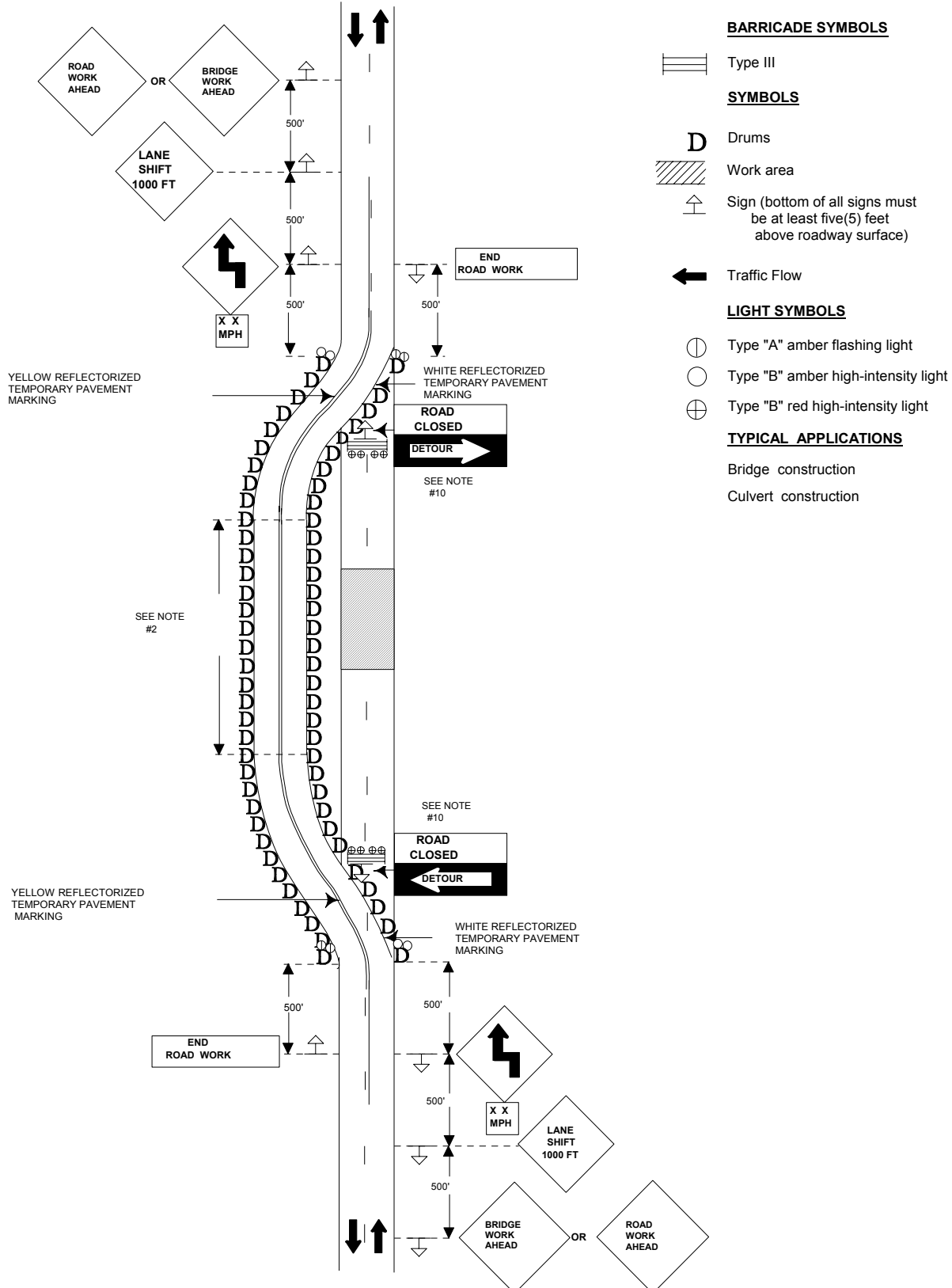
STATIONARY SHORT-TERM PORTABLE TRAFFIC SIGNAL OPERATION ON A TWO-LANE TWO-WAY ROADWAY

General Notes

1. Contractor shall submit a plan indicating the placement and operation of the portable traffic signals to the Engineer for approval 10 days prior to use. Portable traffic signals must be of a type approved for use on construction/utility or maintenance operations required by the Engineer.
2. Additional signing and devices shall be installed as required by the Engineer.
3. Portable traffic signals shall not be used where:
 - a) Approaching speeds are greater than 40 M.P.H.
 - b) Sight distance to the signals is less than required in the MUTCD.
 - c) Overhead signals are required by field conditions.
4. The operator must have an unobstructed view of both ends of the roadway segment being controlled when manual controls are in use.
5. If the total distance between each pair of the traffic signals is greater than 1,000 feet or the operator's view of the signal head or traffic flow through the work zone is obstructed, under manual operation a separate operator is required at each end and communication must be maintained between the operators.
6. Signal heads shall be a minimum of four feet off the edge of the travelway, and a minimum of eight feet to the bottom above the roadway. A signal face shall be located on each side of the roadway in each direction.
7. Minimum change interval (yellow) is three (seconds).
8. Minimum clearance interval (red) is determined by the length of the area controlled by the traffic signals and speed of traffic flow through the work area.
9. The contractor/utility company or maintenance department must replace the lamps in accordance with the manufactures recommendations and a record of this must be maintained by the contractor/utility company or maintenance department.
10. The location of the portable traffic signals may be modified, with the project Engineer's approval to obtain the required visibility for both operator and motorists.
11. All vehicles in the work area shall display flashing lights installed for the purpose of warning approaching drivers of a vehicular traffic hazard requiring unusual care in approaching, overtaking, or passing.
12. Provide for alternate operation of the signal during period of failure, either flash, manually or by having manual traffic direction.
13. Have properly skilled maintenance available without undue delay for all emergency calls, including lamp failure.
14. Provide properly skilled maintenance for all components.
15. Maintain the appearance of the installation in a manner consistent with the intention of this manual, with particular emphasis on painting and cleaning of the optical system.
16. Service equipment and lamps as frequently as experience proves necessary to prevent undue failures.
17. Provide adequate stand-by equipment to minimize the interruption of signal operation due to equipment failure.
18. Every controller should be kept in effective operation in strict accordance with its predetermined timing schedule.
19. A careful check of the correctness of time operation of the controller should be made frequently enough to insure its operating in accordance with the planned timing schedule. Timing changes should be made only by authorized persons. A written record shall be made of all timing changes.
20. All traffic signal equipment shall be carefully cleaned and serviced at least as frequently as specified by the manufacturer and more frequently if experience proves it necessary.

STANDARD DESIGN
TYPICAL APPLICATION OF TRAFFIC CONTROL DEVICES FOR
HIGHWAY CONSTRUCTION, MAINTENANCE AND UTILITY OPERATIONS
CASE 10 - A

TWO-LANE, TWO-WAY TRAFFIC, TEMPORARY DETOUR
DAY OR NIGHT OPERATIONS - HEAVY TRAFFIC



CASE 10-A

TWO-LANE, TWO-WAY TRAFFIC, TEMPORARY DETOUR-DAY OR NIGHT OPERATIONS HEAVY TRAFFIC

Where, at any time, any vehicle, equipment, workers or their activities require the closure of both lanes and a temporary runaround is constructed.

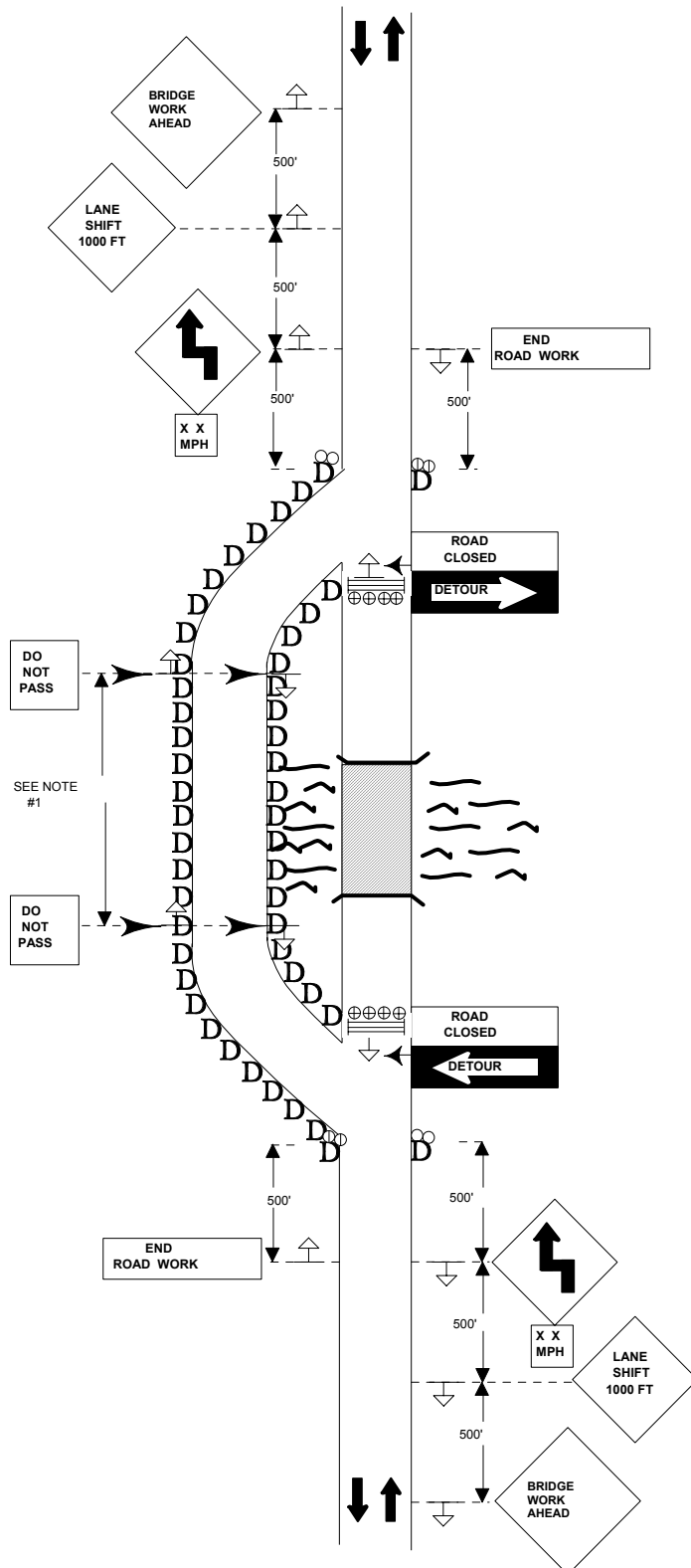
General Notes

1. On the temporary runaround, plastic drums shall be used as shown to mark or outline the travelway.
2. Where the tangent distance (T) on the temporary exceeds 600 feet, amber delineators at 50 foot centers may be substituted for Drums or spacing between drums may be increased to 100 feet within the limits of the tangent.
3. The advisory safe speed to be shown below advance warning signs shall be determined at the site and approved by the Engineer.
4. All signs shall be post mounted if closure time exceeds four (4) days, unless otherwise authorized by the Engineer.
5. A minimum of two (2) AMBER, TYPE B, high-intensity flashing warning lights shall be used at night in advance of the work area. One amber flashing light shall be installed above each of the first two (2) advance warning signs in the series.
6. Longitudinal dimensions may be adjusted slightly to fit field conditions.
7. When a side road intersects the highway on which work is being performed, additional traffic control devices shall be erected as directed by the Engineer.
8. All vehicles in a work area shall display flashing lights installed for the purpose of warning approaching drivers of a vehicular traffic hazard requiring unusual care in approaching, overtaking, or passing.
9. This is the minimum requirement for the condition set forth. The Traffic Engineer may require additional traffic control devices as deemed necessary.
10. Normally Type "B" Red High-Intensity Lights, color to be reviewed by Traffic Engineer.

**STANDARD DESIGN
TYPICAL APPLICATION OF TRAFFIC CONTROL DEVICES FOR
HIGHWAY CONSTRUCTION, MAINTENANCE AND UTILITY OPERATIONS**

CASE 10 - B

**TWO-LANE, TWO-WAY TRAFFIC, TEMPORARY DETOUR
DAY OR NIGHT OPERATIONS - LIGHT TRAFFIC**



BARRICADE SYMBOLS

≡ Type III

SYMBOLS

D Drums

▨ Work area

⏏ Sign (bottom of all signs must be at least five(5) feet above roadway surface)

← Traffic Flow

LIGHT SYMBOLS

⦿ Type "A" amber flashing light

○ Type "B" amber high-intensity light

⊕ Type "B" red high-intensity light

TYPICAL APPLICATIONS

Bridge construction

Culvert construction

CASE 10-B

TWO-LANE, TWO-WAY TRAFFIC, TEMPORARY DETOUR - DAY OR NIGHT OPERATIONS LIGHT TRAFFIC

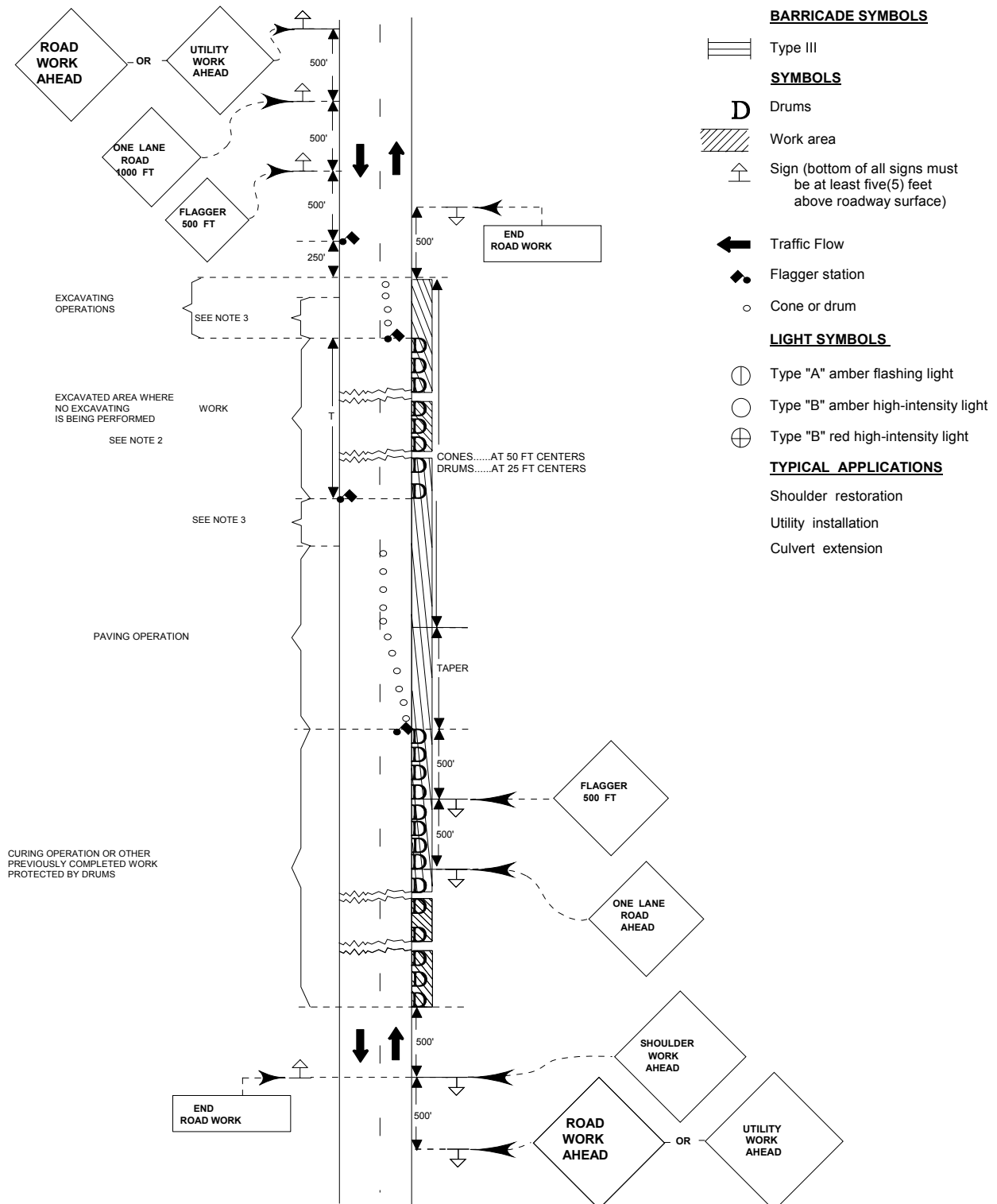
Where, at any time, any vehicle, equipment, workers or their activities require the closure of both lanes and a temporary runaround is constructed.

General Notes

1. On the temporary runaround, amber delineators at 25 foot centers on curves that may be increased to 50 foot spacings within the limits of the (T) tangent, shall be used to mark or outline the travelway. NOTE: Drums may be used instead of delineators with a 50 foot spacing on the curves and a 100 foot spacing on the tangent.
2. The advisory safe speed to be shown below the warning signs shall be determined at the site and approved by the Traffic Engineer.
3. All signs shall be post mounted if the closure time exceeds four (4) days, unless otherwise authorized by the Traffic Engineer.
4. A minimum of two (2) AMBER, TYPE B, high-intensity flashing warning lights shall be used at night in advance of the work area. One amber flashing light shall be installed above each of the first two (2) advance warning signs in the series.
5. Longitudinal dimensions may be adjusted slightly to fit field conditions.
6. When a side road intersects the highway on which work is being performed, additional traffic control devices shall be erected as directed by the Traffic Engineer.
7. All vehicles in a work area shall display flashing lights installed for the purpose of warning approaching drivers of a vehicular traffic hazard requiring unusual care in approaching, overtaking, or passing.
8. This is the minimum requirement for the condition set forth. The Traffic Engineer may require additional traffic control devices as deemed necessary.

STANDARD DESIGN
TYPICAL APPLICATION OF TRAFFIC CONTROL DEVICES FOR
HIGHWAY CONSTRUCTION, MAINTENANCE AND UTILITY OPERATIONS

CASE 11
TWO-LANE, TWO-WAY TRAFFIC, WIDENING OF PAVEMENT
DAY OR NIGHT OPERATIONS



CASE 11

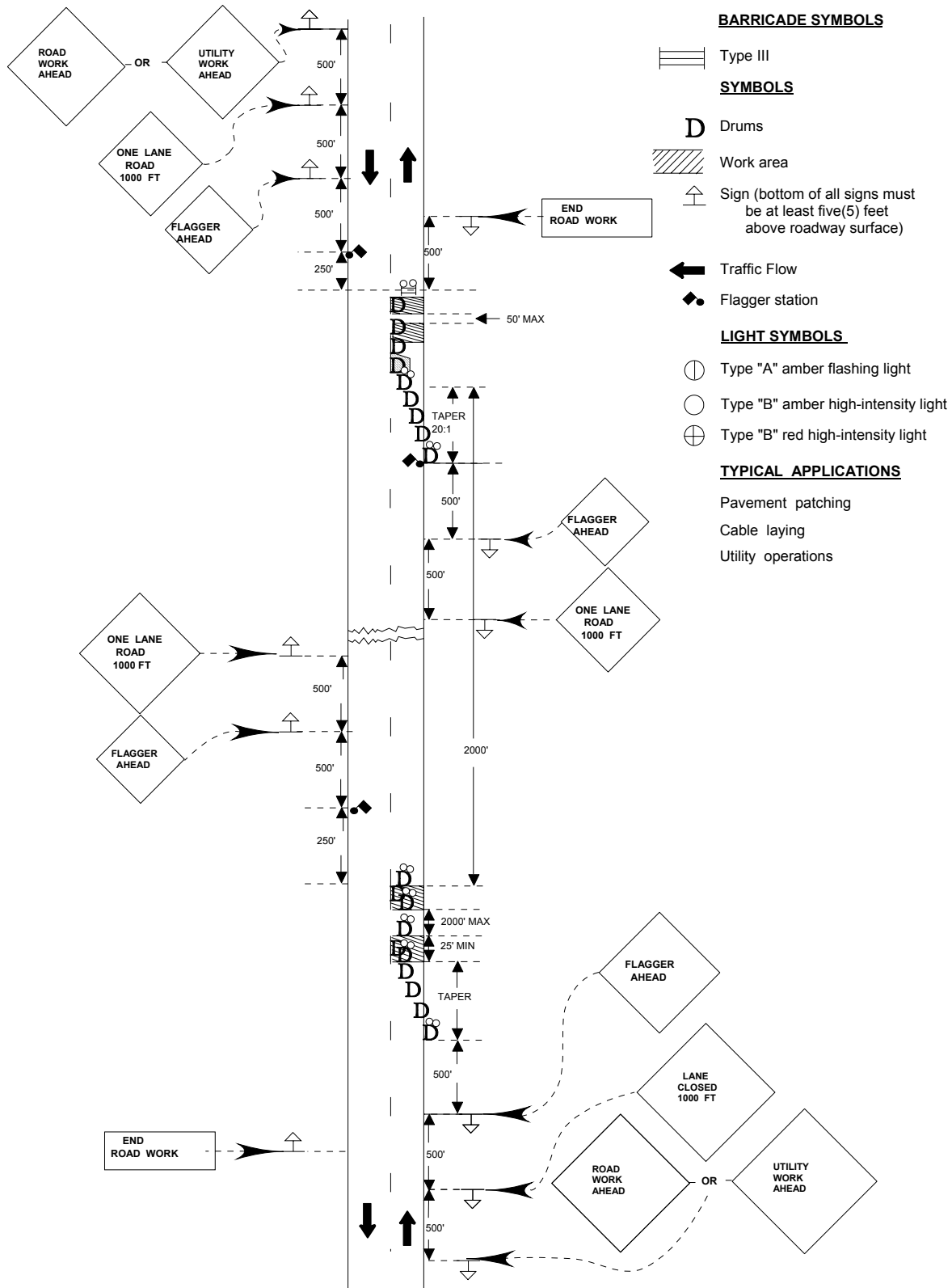
TWO-LANE, TWO-WAY TRAFFIC, WIDENING OF PAVEMENT, DAY OR NIGHT OPERATIONS

Where, at any time, any vehicle, equipment, workers or their activities will encroach on the roadway or pavement during pavement widening operations.

General Notes

1. All vehicles, equipment, workers (except flagger) and their activities are restricted at all times to one side of the pavement, unless otherwise authorized by the Engineer.
2. Where (T) distance exceeds 1,500 feet, additional ONE LANE ROAD 1,000 FEET and FLAGGER 500 FEET signs shall be installed. The cones or drums shall be removed through the (T) area, and an additional taper shall be formed by cones or drums in advance of the area where work is being performed. Additional flagger will be required and the excavated area shall be protected by Drums at 50 foot centers.
3. Minimum distance is 50 feet. When (T) exceeds 1,500 feet, the minimum distance shall be 100 feet.
4. No paving or excavating operations shall be performed at night, unless authorized by the Engineer. When these operations are suspended, all vehicles and equipment, including traffic control and protective devices, shall be removed from the pavement and the excavated area shall be protected by Drums at 50 foot centers. The ONE LANE ROAD 1000 FEET and FLAGGER 500 FEET sign as shown shall be removed.
5. Construction, maintenance, or utility operations shall be confined to one traffic lane, leaving the opposite lane open to traffic. At least 500 feet of both traffic lanes shall be available for traffic movements at intervals not greater than 1,000 feet. A complete traffic control plan must be approved for any project expected to exceed 1,000 feet in length, including both taper and work areas.
6. The flaggers shall be in sight of each other or in communications at all times.
7. All signs shall be post mounted if the closure time exceeds four (4) days, unless otherwise authorized by the Engineer.
8. A minimum of two (2) AMBER, TYPE B, high-intensity flashing warning lights shall be used at night in advance of the work area. One amber flashing light shall be installed above each of the first two (2) advance warning signs in the series.
9. Longitudinal dimensions may be adjusted slightly to fit field conditions.
10. When a side road intersects the highway on which work is being performed, additional traffic control devices shall be erected as directed by the Engineer.
11. All vehicles in a work area shall display flashing lights installed for the purpose of warning approaching drivers of a vehicular traffic hazard requiring unusual care in approaching, overtaking, or passing.
12. This is the minimum requirement for the condition set forth. The Traffic Engineer may require additional traffic control devices as deemed necessary.
13. Cones may be substituted for Drums during day operations.

STANDARD DESIGN
TYPICAL APPLICATION OF TRAFFIC CONTROL DEVICES FOR
HIGHWAY CONSTRUCTION, MAINTENANCE AND UTILITY OPERATIONS
CASE 12
TWO-LANE, TWO-WAY TRAFFIC, WORK AREAS IN SERIES
DAY OR NIGHT OPERATIONS



CASE 12

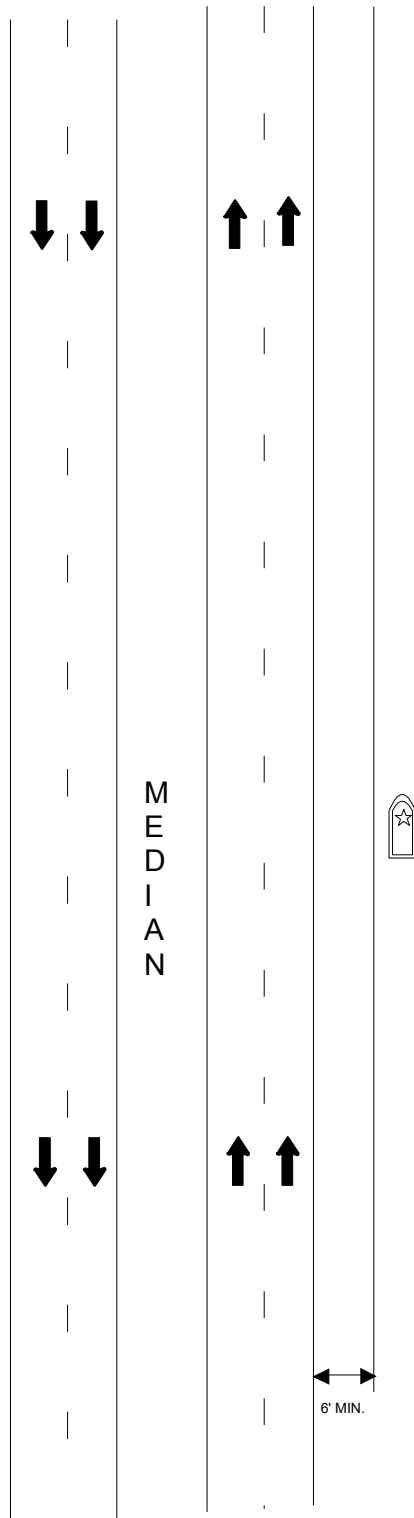
TWO-LANE, TWO-WAY TRAFFIC, WORK AREAS IN SERIES DAY OR NIGHT OPERATIONS

Where, at any time, any vehicle, equipment, worker or their activities will encroach in the area between the centerline and the outside of the roadway or pavement.

General Notes

1. All vehicles, equipment, workers (except FLAGGER) and their activities are restricted at all times to one side of the pavement, unless otherwise authorized by the Traffic Engineer.
2. When the distance between successive patches is less than 2,000 feet, the entire operation will be considered as one work area. When the distance between successive patches exceeds 2,000 feet, additional advance warning signs as shown shall be installed. Under restricted sight distance conditions, such additional warning signs may also be required for distances less than 2,000 feet at the discretion of the Engineer.
3. Construction, maintenance or utility operations shall be confined to one traffic lane, leaving the opposite lane open traffic. At least 500 feet of both lanes shall be available for traffic movements at intervals not greater than 4,000 feet. A complete traffic control plan must be approved for any project expected to exceed 4,000 feet in length including both taper and work areas.
4. Two (2) FLAGGERS shall be required for each separate operation where successive patches are more than 2,000 feet apart, unless otherwise authorized by the Engineer, due to low volume of traffic. Where successive patches are more than 50 feet, but less than 2,000 feet apart, Drums with one (1) AMBER TYPE "B" flashing warning lights as shown shall be placed on the pavement beyond and in advance of the patches.
5. The FLAGGER's shall be in sight of each other or in communications at all times.
6. When there is no work being performed, FLAGGER AHEAD signs and the FLAGGER will not be required, ONE LANE ROAD 500 FEET signs shall be installed in place of the FLAGGER AHEAD signs. Traffic may use shoulder when authorized by the Engineer. An unattended obstacle or excavation in the work area shall be protected by Drums. At night one (1) AMBER TYPE "B" flashing lights shall be installed above the Drums.
7. A minimum of two (2) TYPE "B" high-intensity flashing warning lights shall be used at night on each approach in advance of the work area. One AMBER flashing light shall be installed above each of the first two (2) advance warning signs in the series.
8. Cones may be substituted for Drums during day operations.
9. All signs shall be post mounted if the closure time exceeds four (4) days, unless otherwise authorized by the Engineer.
10. Longitudinal dimensions may be adjusted slightly to fit field conditions.
11. When a side road intersects the highway on which work is being performed, additional traffic control devices shall be erected as directed by the Engineer.
12. All vehicles in a work area shall display flashing lights installed for the purpose of warning approaching drivers of a vehicular traffic hazard requiring unusual care in approaching, overtaking, or passing.

STANDARD DESIGN
TYPICAL APPLICATION OF TRAFFIC CONTROL DEVICES FOR
HIGHWAY CONSTRUCTION, MAINTENANCE AND UTILITY OPERATIONS
CASE 13
MULTILANE DIVIDED, DAY OR NIGHT OPERATIONS
OVER 6 FEET FROM EDGE OF PAVEMENT



SYMBOLS



Work Vehicle with Rotating
Amber Beacon or Strobe



Traffic Flow

TYPICAL APPLICATIONS

Landscaping work

Utility construction or maintenance

Fencing contracts or maintenance

Cleaning culverts

CASE 13

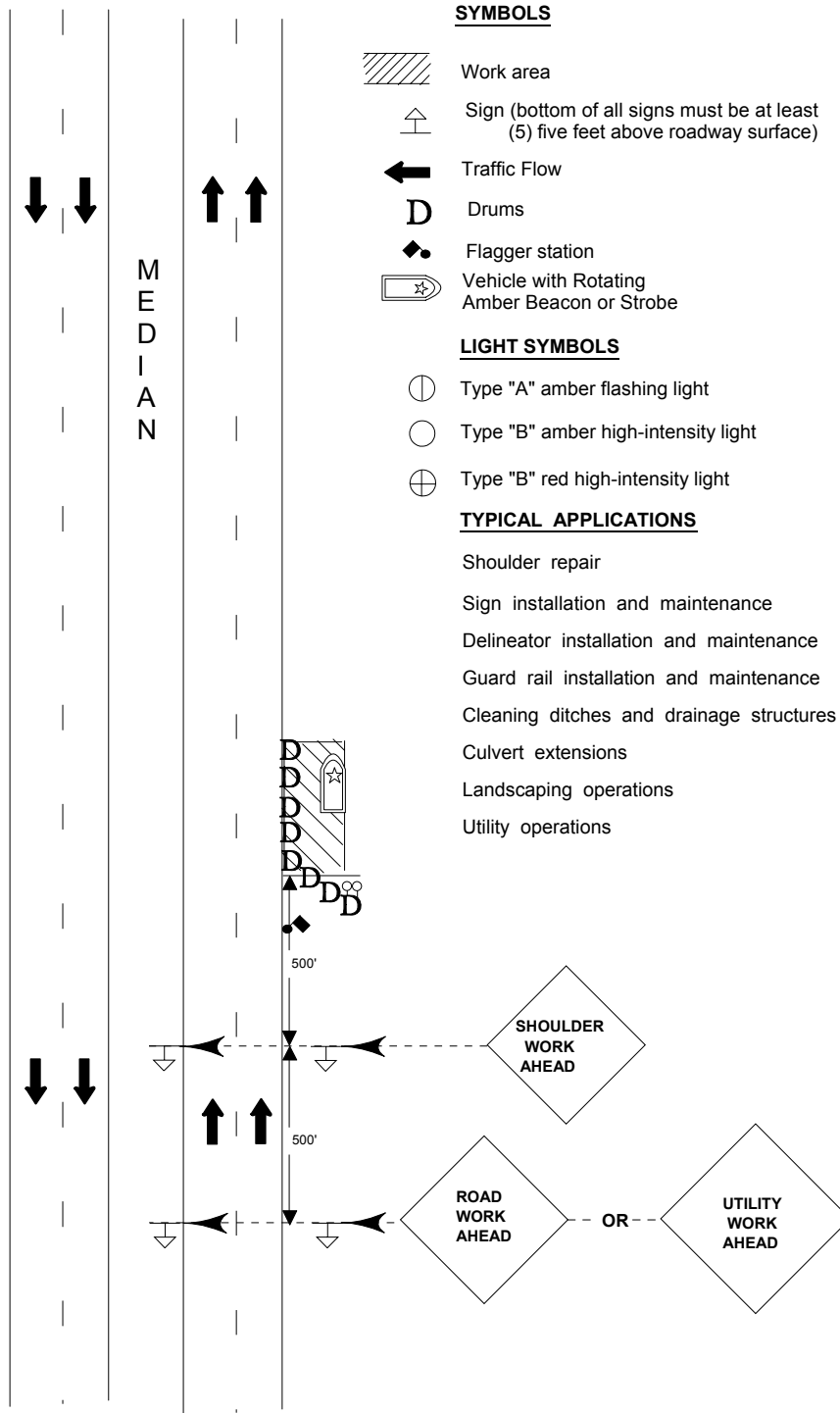
MULTILANE DIVIDED, DAY OR NIGHT OPERATIONS OVER 6 FEET FROM EDGE OF PAVEMENT

Where, at all times, all vehicles, equipment, workers and their activities are more than the width of the shoulder from the travelway or six(6) feet which ever is greater.

General Notes

1. No special signing is required.
2. If the work operation requires that two (2) or more work vehicles cross the six (6) foot clear zone in any one hour, traffic control will be in conformance with Case 14.
3. This case also applies when work is being performed on a multilane undivided highway.
4. This case also applies to work performed in the median more than six (6) feet from either pavement.
5. Utility companies may work on utility crossings on fully access controlled freeways under emergency conditions only.
6. All vehicles in a work area shall display flashing lights installed for the purpose of warning approaching drivers of a vehicular traffic hazard requiring unusual care in approaching, overtaking, or passing.
7. This is the minimum requirement for the condition set forth. The Traffic Engineer may require additional traffic control devices as deemed necessary.

STANDARD DESIGN
TYPICAL APPLICATION OF TRAFFIC CONTROL DEVICES FOR
HIGHWAY CONSTRUCTION, MAINTENANCE AND UTILITY OPERATIONS
CASE 14
MULTILANE, DIVIDED, DAY OR NIGHT OPERATIONS - SHOULDER CLOSED



CASE 14

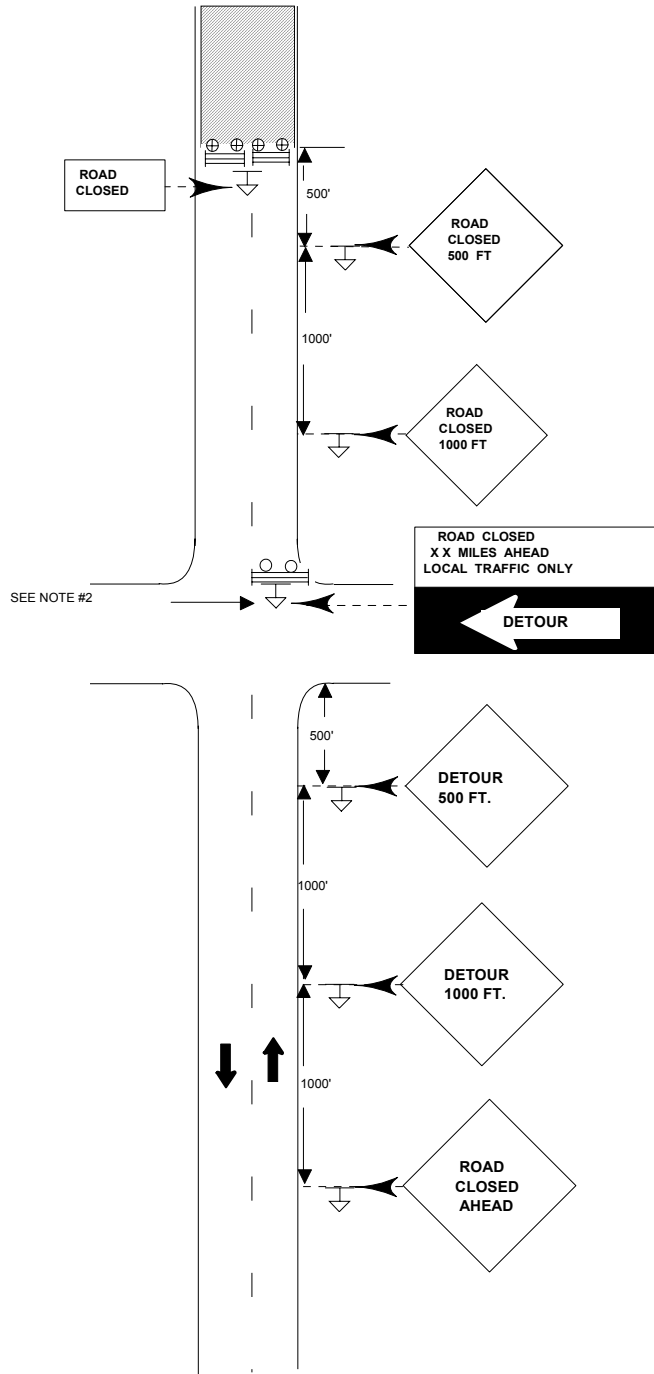
MULTILANE, DIVIDED, DAY OR NIGHT OPERATIONS - SHOULDER CLOSURE

Where, at any time, equipment, workers or their activities will encroach in the area closer than six (6) feet, but not closer than the edge of the roadway or pavement.

General Notes

1. All vehicles, equipment, workers (except FLAGGER) and their activities are restricted at all times to one side of the pavement, unless otherwise authorized by the Traffic Engineer.
2. If the work operation requires that four (4) or more vehicles enter the through traffic lanes in a one (1) hour period, a FLAGGER shall be provided and the FLAGGER AHEAD sign shall be substituted for the SHOULDER WORK sign.
3. If the work operation does not exceed one (1) hour, traffic control will be in conformance with Case 7-C.
4. WORKERS or FLAGGER AHEAD signs are to be removed when no work is being performed and replaced with proper advance warning signs. Any unattended obstacle or excavation in the work area shall be protected by Drums.
5. A minimum of two (2) AMBER, TYPE B flashing warning lights shall be used at night in advance of the work area. One (1) amber flashing light shall be installed above each of the first two (2) advance warning signs in the series.
6. This case also applies to work performed in the median area.
7. This case also applies when work is being performed on a multilane undivided highway. Under these conditions, the signs normally mounted in the median shall be omitted.
8. All signs are to be removed at completion of the day's operations, if there are no hazards adjacent to the travelway.
9. Utility companies may work on utility crossings on fully access controlled freeway under emergency conditions only.
10. Longitudinal dimensions may be adjusted slightly to fit field conditions.
11. All vehicles in a work area shall display flashing lights installed for the purpose of warning approaching drivers of a vehicular traffic hazard requiring unusual care in approaching, overtaking, or passing.
12. This is the minimum requirement for the condition set forth. The Traffic Engineer may require additional traffic control devices as deemed necessary.
13. Cones may be used in lieu of drums during daylight operations. Reflectorized cones may be used in lieu of drums for a single night operation (emergency work) that is continuously manned.

STANDARD DESIGN
TYPICAL APPLICATION OF TRAFFIC CONTROL DEVICES FOR
HIGHWAY CONSTRUCTION, MAINTENANCE AND UTILITY OPERATIONS
CASE 15 - A
TWO-LANE, TWO-WAY TRAFFIC DETOUR FOR DAY OR NIGHT OPERATIONS



BARRICADE SYMBOLS

≡ Type III

SYMBOLS

▨ Work area

⊕ Sign (bottom of all signs must be at least five(5) feet above roadway surface)

← Traffic Flow

LIGHT SYMBOLS

⊙ Type "A" amber flashing light

○ Type "B" amber high-intensity light

⊕ Type "B" red high-intensity light

TYPICAL APPLICATIONS

Bridge construction

Culvert construction

CASE 15-A

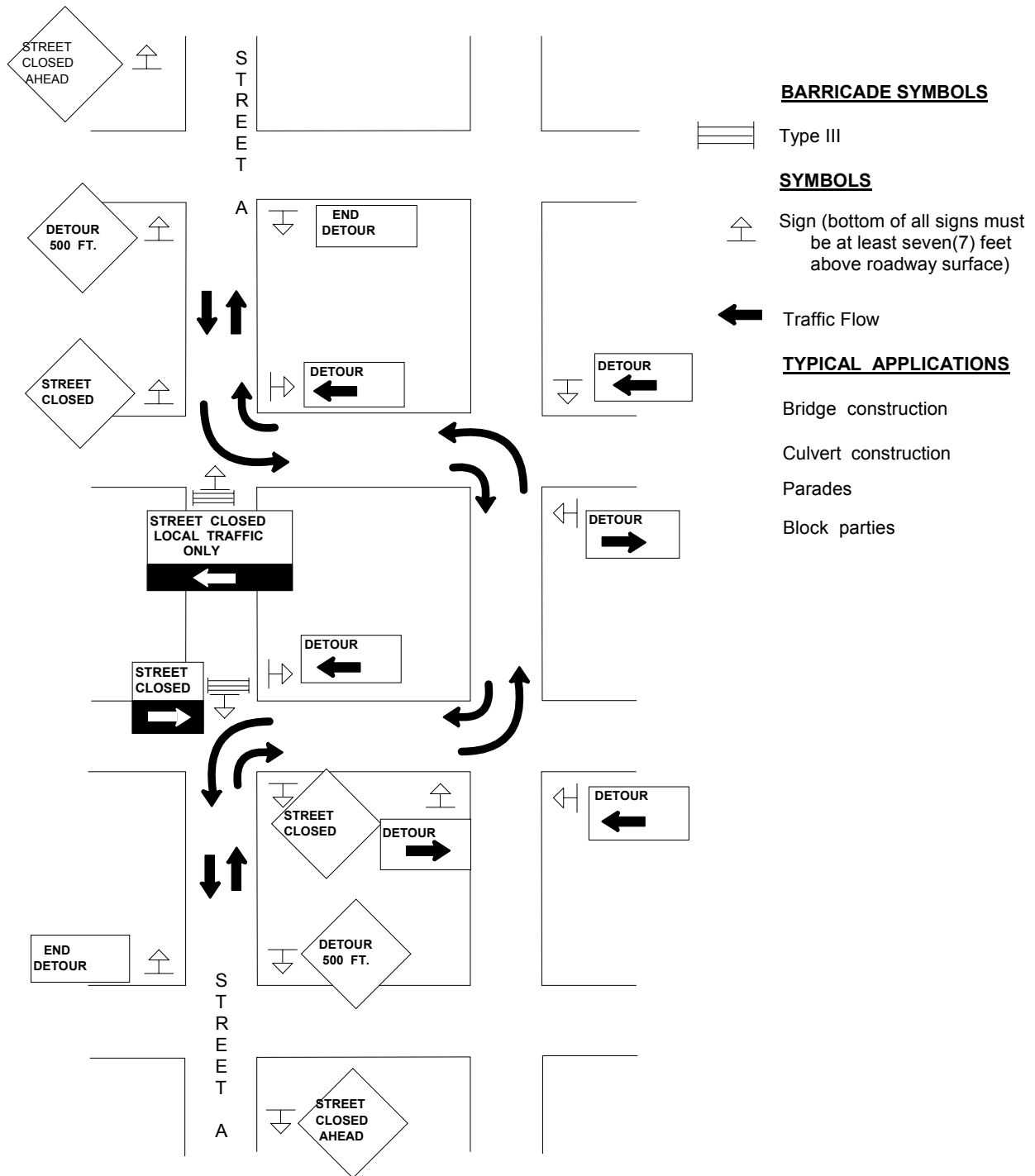
TWO-LANE, TWO-WAY TRAFFIC DETOUR FOR DAY OR NIGHT OPERATIONS

Where, at any time, any vehicle, equipment, worker or their activities require the closure of a street or highway and a detour is in effect.

General Notes

1. A minimum of six (6) Amber, Type B, flashing lights shall be used at night. One (1) Amber flashing light shall be installed above the first and second warning sign in advance of the detour. Two (2) Amber flashing lights installed on top of the Type III barricade at the point of detour, and one (1) Amber flashing light shall be installed above each of the two (2) warning signs in advance of the point of closure.
2. If the roadway is signed to stop, two (2) Red, Type B flashing lights shall be installed above the stop sign and two (2) Red, Type B flashing lights shall be installed above the barricade at point of detour. If only the cross street or road is signed to stop, the flashing lights on the barricade shall be Amber and lights on stop sign omitted.
3. The barricades, at the point of closure, shall have two (2) Red, Type B flashing lights over each travel lane.
4. All signs shall be postmounted if the closure time exceeds four (4) days, unless otherwise authorized by the Engineer.
5. When a side road intersects the highway on which work is being performed, additional traffic control devices shall be erected as directed by the Engineer.
6. Longitudinal dimensions may be adjusted slightly to fit field conditions.
7. All vehicles in a work area shall display flashing lights installed for the purpose of warning approaching drivers of a vehicular traffic hazard requiring unusual care in approaching, overtaking, or passing.
8. This is the minimum requirement for the condition set forth. The Traffic Engineer may require additional traffic control devices as deemed necessary.

STANDARD DESIGN
TYPICAL APPLICATION OF TRAFFIC CONTROL DEVICES FOR
HIGHWAY CONSTRUCTION, MAINTENANCE AND UTILITY OPERATIONS
CASE 15 - B
TWO-LANE, TWO-WAY, TRAFFIC URBAN DETOUR FOR
DAY OR NIGHT OPERATIONS



CASE 15-B

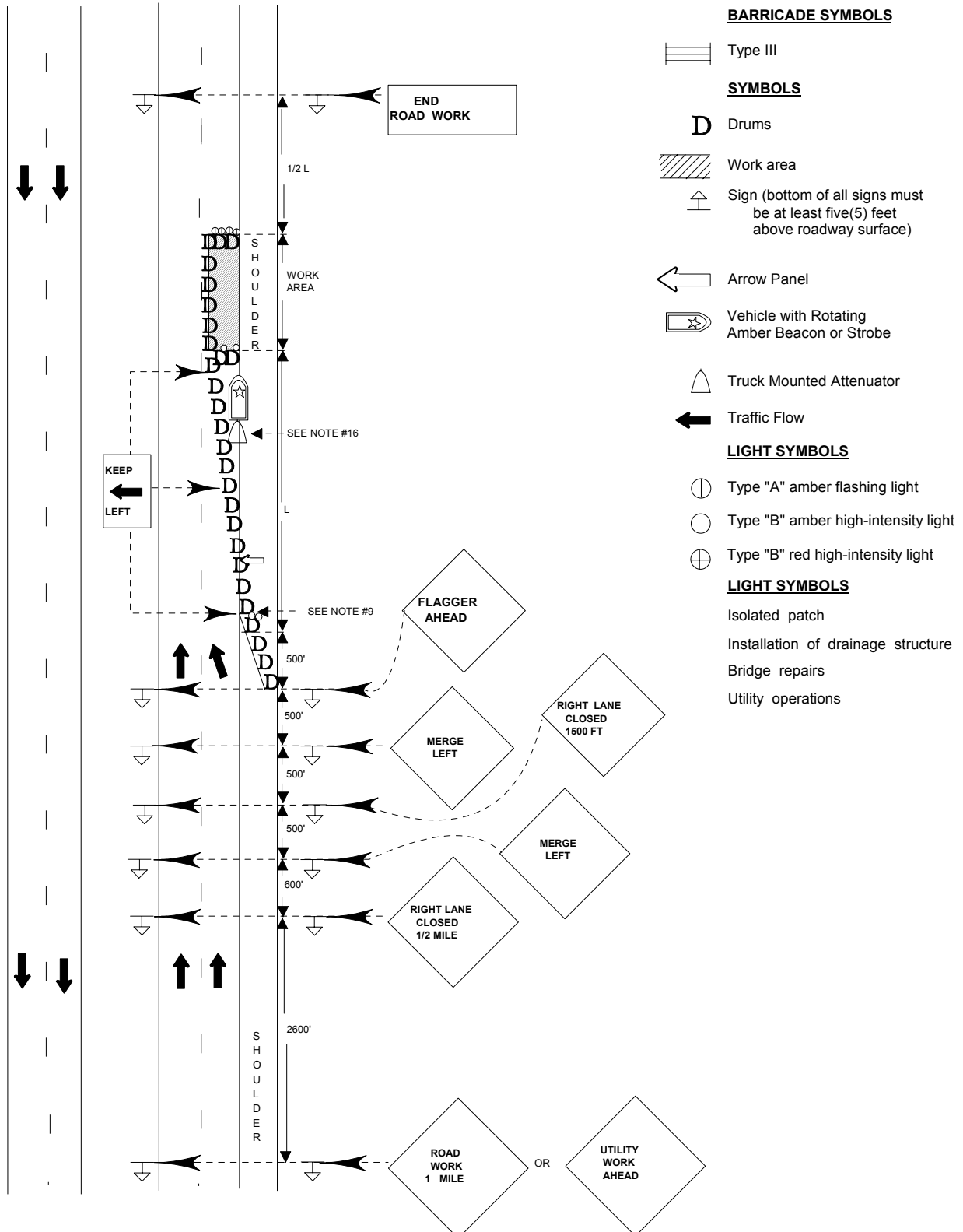
TWO-LANE, TWO-WAY TRAFFIC URBAN DETOUR FOR DAY OR NIGHT OPERATIONS

Where, at any time, any vehicle, equipment, worker and their activities including parades, block parties, or any other activities that require the closure of a street, and a detour is in effect.

General Notes

1. ONE (1) AMBER, TYPE B flashing warning light shall be installed above each of the first two warning signs in advance of the detour.
2. If Street "A" has a stop condition at the point of closure, the advance warning (STREET CLOSED, DETOUR 500 FT. and STREET CLOSED AHEAD) signs may be omitted.
3. Two (2) RED, TYPE B flashing warning lights shall be installed on top of the Type III barricade that closes the street to all traffic.
4. One (1) AMBER, TYPE B flashing warning lights shall be installed on top of the Drum at the point of detour where local traffic is permitted access to nearer points than the actual closure.
5. All signs shall be post mounted if the closure time exceeds four (4) days, unless otherwise authorized by the Engineer.
6. When a side street intersects the street on which work is being performed, additional traffic control devices shall be erected as directed by the Engineer.
7. Longitudinal dimensions may be adjusted slightly to fit field conditions.
8. All vehicles in a work area shall display flashing lights installed for the purpose of warning approaching drivers of vehicular traffic hazard requiring unusual care in approaching drivers of a vehicular traffic hazard requiring unusual care in approaching, overtaking, or passing.
9. This is the minimum requirement for the condition set forth. The Traffic Engineer may require additional traffic control devices as deemed necessary.

STANDARD DESIGN
TYPICAL APPLICATION OF TRAFFIC CONTROL DEVICES FOR
HIGHWAY CONSTRUCTION, MAINTENANCE AND UTILITY OPERATIONS
CASE 16
MULTILANE, DIVIDED, OPERATIONS
EXCEEDING ONE DAYLIGHT OPERATION



CASE 16

MULTILANE, DIVIDED, OPERATIONS EXCEEDING ONE DAYLIGHT OPERATION

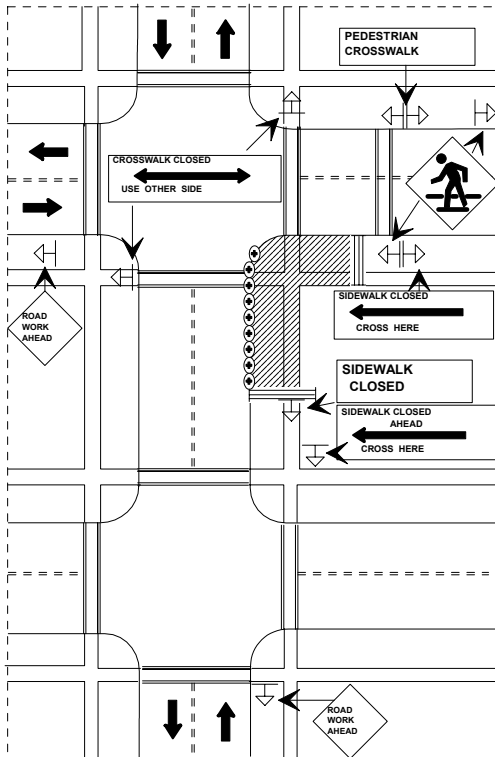
Where, at any time, any vehicle, equipment, worker or their activities will encroach in the area between the centerline and the outside of the roadway or pavement.

General Notes

1. All vehicles, equipment, workers (except FLAGGER) and their activities are restricted at all times to one side of the pavement, unless otherwise authorized by the Traffic Engineer.
2. The "L" distance equals the lane width times the posted speed limit. Controlled access highways shall have a minimum taper of 1000'.
3. When authorized by the Engineer, the first two (2) warning signs in the series shall be omitted and the merge sign shall be replaced with ROAD OR UTILITY CONSTRUCTION AHEAD.
4. When traffic volumes permit or there is no work being performed, the FLAGGER signs and the FLAGGER will not be required. RIGHT LANE CLOSED 500 FEET sign(s) shall be installed in place of the FLAGGER sign(s).
5. This case also applies when work is being performed in the LEFT hand most lane of a Multilane Highway. Under these conditions. LEFT LANE CLOSED 500 FEET signs shall be substituted for RIGHT LANE CLOSED 500 FEET signs and MERGE RIGHT signs shall be substituted for MERGE LEFT signs. Also, KEEP RIGHT signs shall be substituted for KEEP LEFT.
6. For multilane undivided roadways, the signs in the median are omitted. Signs shall be added in the opposite direction in conformance with CASE 4.
7. This case does not apply when work is being performed in the middle lane(s) of a six or more lane highway. Special plans, approved by the Engineer, will be required.
8. Cones may be substituted for Drums during day operations.
9. Drums used on tapers shall be placed at approximately right angles to the traffic flow and at not more than 25 ft. intervals for the first four (4) Drums and not more than 50 ft. intervals for all other required.
10. A minimum of two (2) AMBER, TYPE B, high-intensity flashing warning lights shall be used at night in advance of the work area.
11. Drums shall be equipped with one (1) amber Type "B" flashing lights at the point of hazard. One (1) amber Type "B" flashing lights shall be used on the first drum in the series for delineation.
12. All signs shall be post mounted if closure time exceeds four (4) days, unless otherwise authorized by the Traffic Engineer.
13. Longitudinal dimensions may be adjusted slightly to fit field conditions.
14. When a side road intersects the highway on which work is being performed, additional traffic control devices shall be erected as directed by the Engineer.
15. All vehicles in a work area shall display flashing lights installed for the purpose of warning approaching drivers of a vehicular traffic hazard requiring unusual care in approaching, overtaking, or passing.
16. Vehicle with appropriately rated truck mounted attenuator shall be used on roadways with posted speed limits in excess of 35 mph.

STANDARD DESIGN
TYPICAL APPLICATION OF TRAFFIC CONTROL DEVICES FOR
HIGHWAY CONSTRUCTION, MAINTENANCE AND UTILITY OPERATIONS
CASE 17

CROSSWALK CLOSURES AND PEDESTRIAN DETOURS
DAY OR NIGHT OPERATIONS



BARRICADE SYMBOLS

≡ Type III

SYMBOLS

⊕ Sign (bottom of all signs must be at least seven(7) feet above roadway surface)

← Traffic Flow

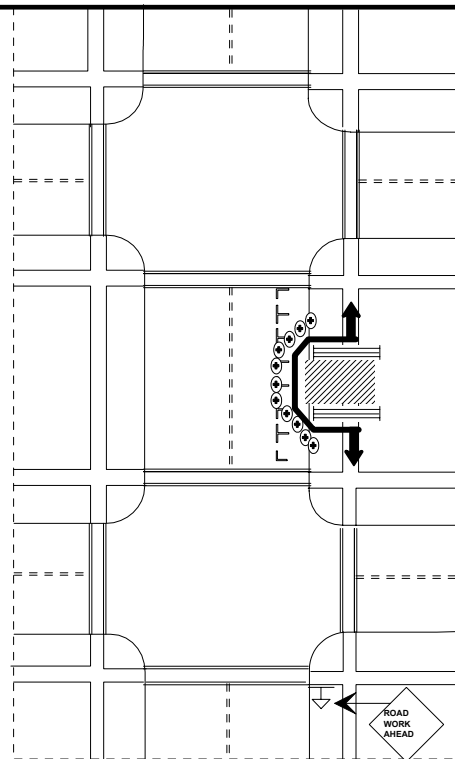
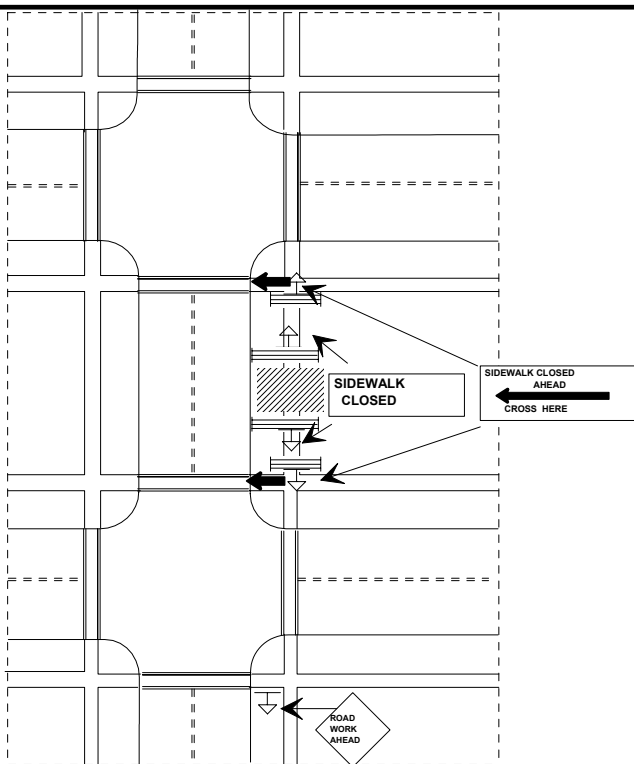
⊕ CHANNELIZING DEVICES:
can be Plastic Drums,
or Cones

LIGHT SYMBOLS

⊙ Type "A" amber flashing light

○ Type "B" amber high-intensity light

⊕ Type "B" red high-intensity light

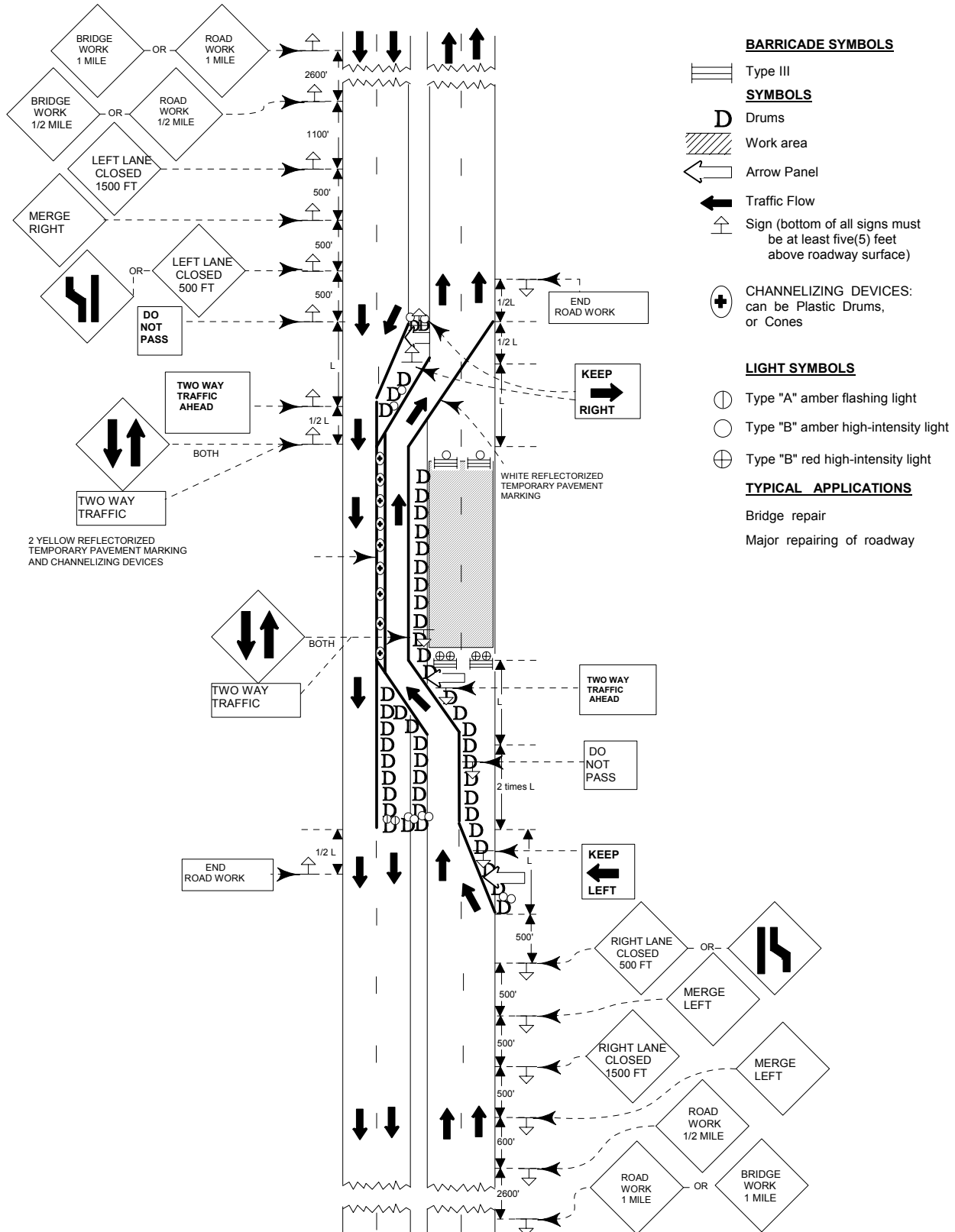


Case 17

Crosswalk Closures and Pedestrian Detours

1. Only the traffic control devices controlling pedestrian flows are shown. Other devices may be needed to control traffic on the streets. Use lane closure signing or ROAD NARROWS signs, as needed.
2. Street lighting should be considered.
3. Pedestrian traffic signal displays controlling closed crosswalks should be covered or deactivated.
4. Where high speeds may be anticipated, use a barrier to separate the temporary walkway from vehicular traffic.
5. Signs may be placed along a temporary walkway to guide or direct pedestrians. Examples include KEEP RIGHT and KEEP LEFT signs.

STANDARD DESIGN
TYPICAL APPLICATION OF TRAFFIC CONTROL DEVICES FOR
HIGHWAY CONSTRUCTION, MAINTENANCE AND UTILITY OPERATIONS
CASE 18
MULTILANE, DIVIDED, DAY OR NIGHT OPERATIONS



CASE 18

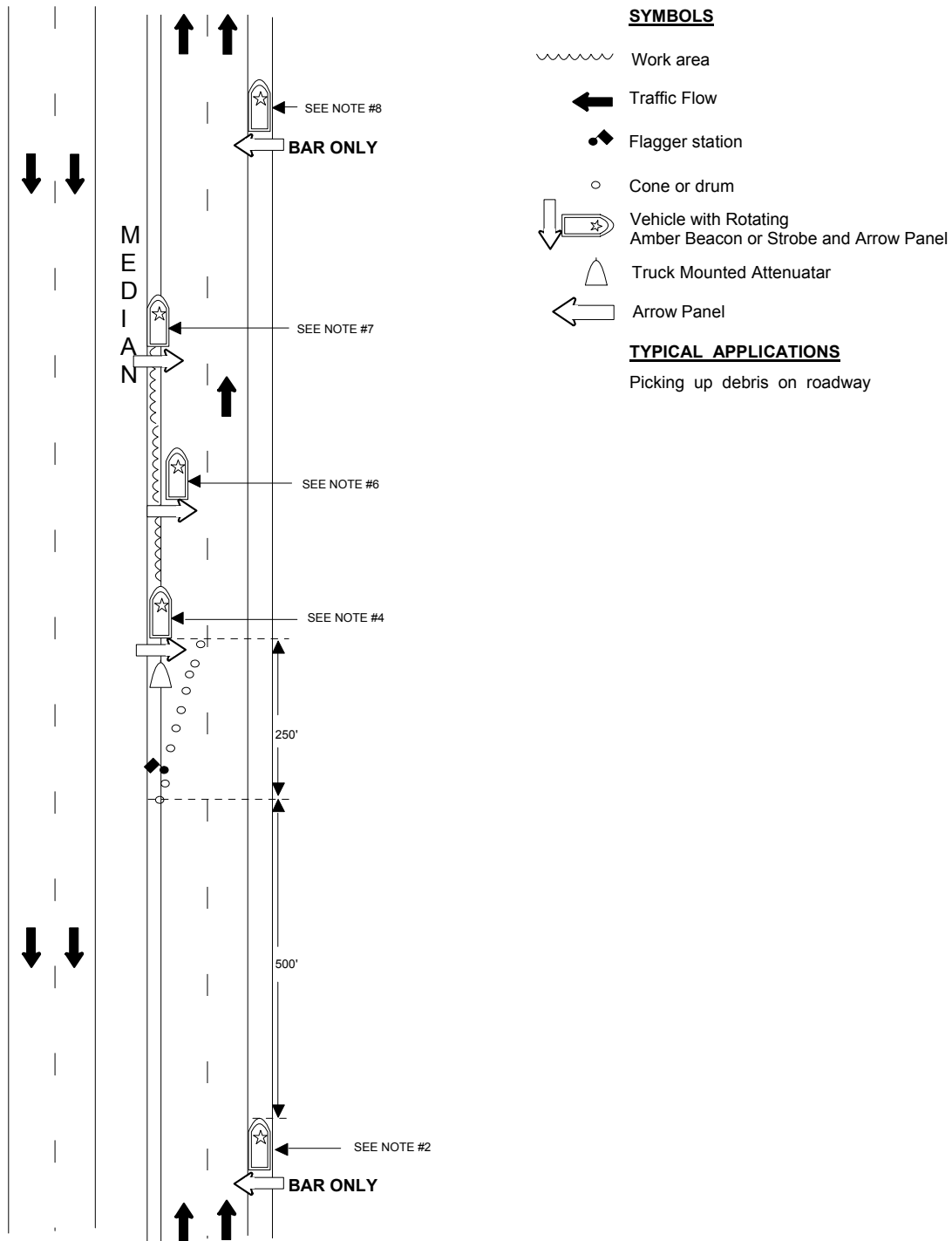
MULTILANE, DIVIDED, DAY OR NIGHT OPERATIONS

Where, at any time, any vehicle, equipment, worker or their activities require the closure of two adjacent lanes and a temporary crossover is provided by making use of one lane of roadway or pavement normally used by the opposing flow of traffic.

General Notes

1. All vehicles, equipment, workers (except FLAGGER) and their activities are restricted at all times to one side of the pavement, unless otherwise authorized by the Traffic Engineer.
2. The "L" distance equals the lane width times the posted speed limit.
3. Where a FLAGGER is required, the LANE CLOSED 500 FEET sign(s) shall be replaced with FLAGGER AHEAD signs.
4. A minimum of two (2) AMBER, TYPE B, high-intensity flashing warning lights shall be used at night in advance of the work areas. One (1) AMBER flashing light shall be installed above each of the first two (2) advance warning signs in the series.
5. Drums shall be equipped with one (1) amber Type "B" flashing lights at the point of hazard. One (1) amber Type "B" flashing lights shall be used on the first two(2) Drums in the series for delineation.
6. All signs shall be post mounted if closure time exceeds four (4) days, unless otherwise authorized by the Traffic Engineer.
7. Longitudinal dimensions may be adjusted slightly to fit field conditions.
8. When a side road intersects the highway on which work is being performed, additional traffic control devices shall be erected as directed by the Engineer.
9. All vehicles in a work area shall display flashing lights installed for the purpose of warning approaching drivers of a vehicular traffic hazard requiring unusual care in approaching, overtaking, or passing.
10. This is the minimum requirement for the condition set forth. The Traffic Engineer may require additional traffic control devices as deemed necessary.
11. Two way traffic shall be separated with either: positive barrier, cones, drums, vertical panels, or flexible guide markers.

STANDARD DESIGN
TYPICAL APPLICATION OF TRAFFIC CONTROL DEVICES FOR
HIGHWAY CONSTRUCTION, MAINTENANCE AND UTILITY OPERATIONS
CASE 19 - A
UNDER EXTREME EMERGENCY OPERATIONS ONLY
ALL TRUCKS MUST HAVE ARROW PANELS



CASE 19-A

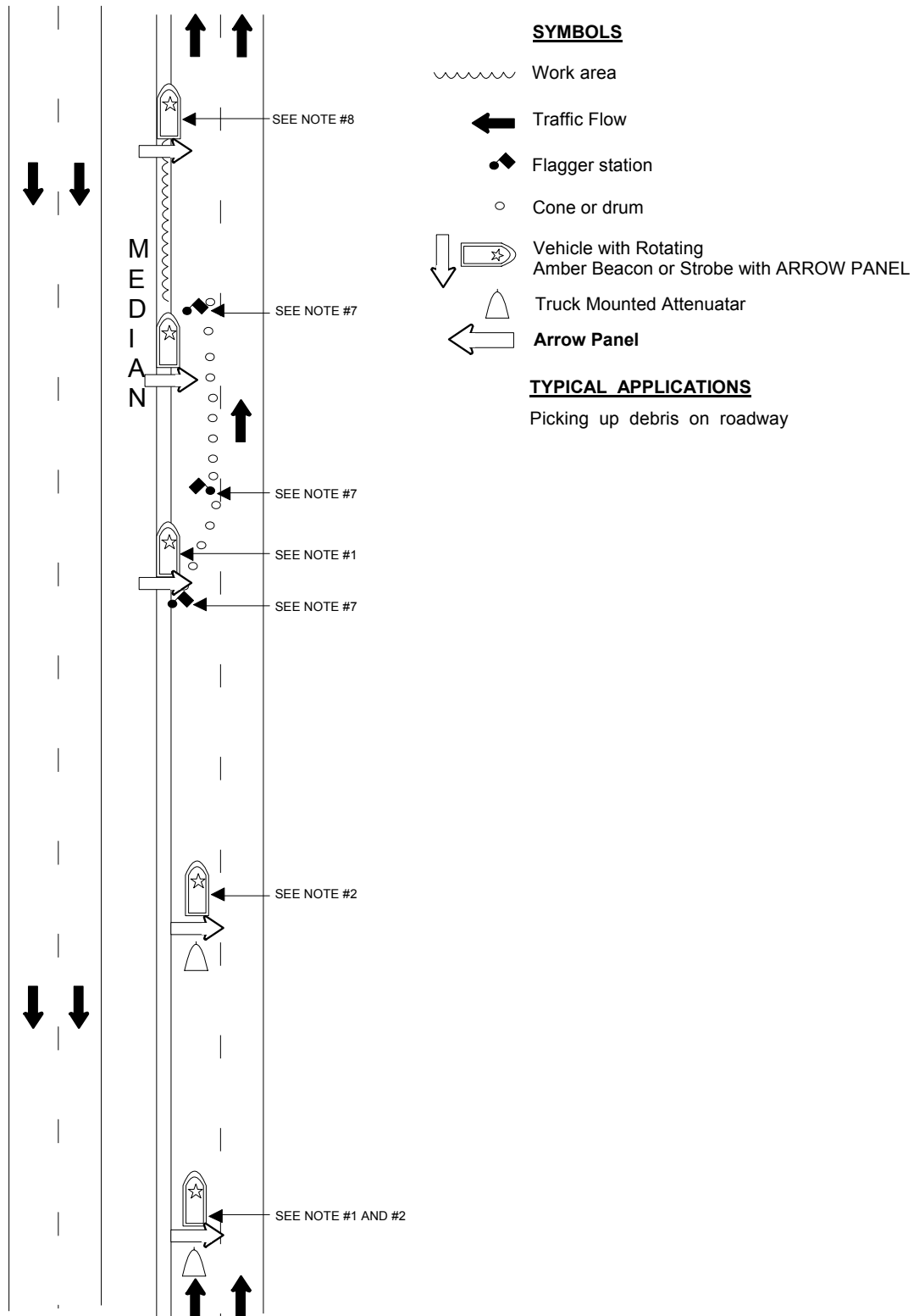
UNDER EXTREME EMERGENCY OPERATIONS ONLY

Where, at any time, any vehicle, equipment, worker or their activities will require the closure of a travel lane.

General Notes

1. Turn on all flashers and other warning devices just prior to slowing for stop.
2. Stop the truck on the right hand shoulder, at a point with excellent sight distance, at least 500 feet from the site of debris.
3. At a point of about 250 feet from the site of the debris, place a FLAGGER on the left shoulder area and have him/her immediately start signaling traffic to keep right. The other two workers should then quickly set up a taper using fuse flares or cones. The FLAGGER should move behind the flares, but stay very near the left shoulder.
4. This vehicle must have an arrow panel that is in operation. The truck should then be brought into the left lane and parked behind the debris with the right edge about two feet off the center line. If no natural gap appears in the traffic stream to allow this, two workers should flag traffic to a stop while it is done. Each worker should stay as far off the roadway as possible until several vehicles have stopped. This vehicle shall be equipped with an impact attenuator, (TMA).
5. Once the truck is in place, the workers should gather the debris into a pile as near the wall or median as possible.
6. The truck should then be driven around the pile of debris, preferably without encroachment into the open lane, with one FLAGGER at the truck while the other drives.
7. The debris should be loaded as quickly as possible because this is the time of longest exposure to high danger.
8. After the debris is loaded, the truck should be returned to the right hand shoulder.
9. The FLAGGER should quickly clear the flares or cones to the left shoulder and when finished, cross (when safe) over and walk up the right hand shoulder to the truck. The flagger must carry a fuse flare and walk as closely to the wall as possible.
10. To close the right lane, this procedure shall be reversed.
11. The above condition should be considered as being the most hazardous. A normal condition should involve two (2) trucks and shall be in conformation with Case 19-B.
12. All vehicles in a work area shall display flashing lights installed for the purpose of warning approaching drivers of a vehicular traffic hazard requiring unusual care in approaching, overtaking, or passing.
13. This is the minimum requirement for the condition set forth. The Traffic Engineer may require additional traffic control devices as deemed necessary.

STANDARD DESIGN
TYPICAL APPLICATION OF TRAFFIC CONTROL DEVICES FOR
HIGHWAY CONSTRUCTION, MAINTENANCE AND UTILITY OPERATIONS
CASE 19 - B
UNDER EMERGENCY OPERATIONS ONLY



CASE 19-B

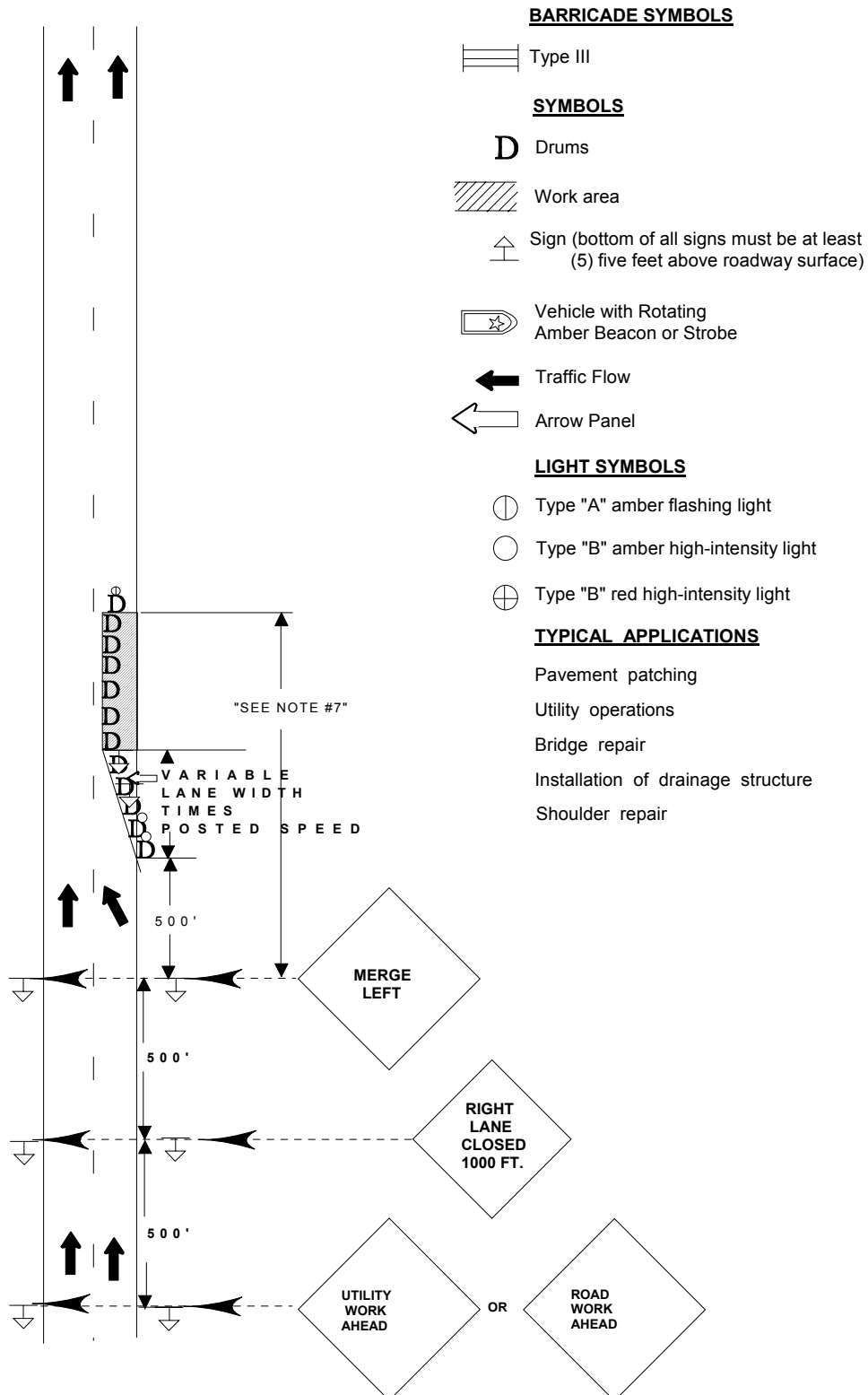
UNDER EMERGENCY OPERATIONS ONLY

Where, at any time, any vehicle, equipment, worker, or their activities will require the closure of a travel lane.

General Notes

1. Emergency lane closures should be done by two (2) vehicles with a large rotating amber beacon or strobe light. Both vehicles must display an operating arrow panel.
2. Both vehicles should enter the left travel lane several thousand feet before the site of the debris. This vehicle shall be equipped with an impact attenuator, (TMA).
3. While traveling at near normal speed, turn on all warning devices and start to reduce speed slowly.
4. At approximately 25 miles per hour, the last vehicle should pull part way onto the left shoulder.
5. At approximately 300 feet prior to the debris, the last vehicle should stop about one half of the lane.
6. Everyone should exit from the driver's side and go to the back of the vehicle. While one worker flags traffic, the others should set up fuse flares or cones in a taper.
7. One worker will remain to flag while the other two workers flag between the two vehicles.
8. The workers in the other vehicle will pile the debris in front of their vehicle and then move their vehicle to pick it up.
9. The lane is cleared by removing the flares or cones and both vehicles moving off.
10. To close the right lane, this procedure shall be reversed.
11. All vehicles in a work area shall display flashing lights installed for the purpose of warning approaching drivers of a vehicular traffic hazard requiring unusual care in approaching, overtaking, or passing.
12. This is the minimum requirement for the condition set forth. The Traffic Engineer may require additional traffic control devices as deemed necessary.

STANDARD DESIGN
TYPICAL APPLICATION OF TRAFFIC CONTROL DEVICES FOR
HIGHWAY CONSTRUCTION, MAINTENANCE AND UTILITY OPERATIONS
CASE 20
MULTILANE, DIVIDED, FIXED WORK SITE
DAY OR NIGHT OPERATIONS



CASE 20

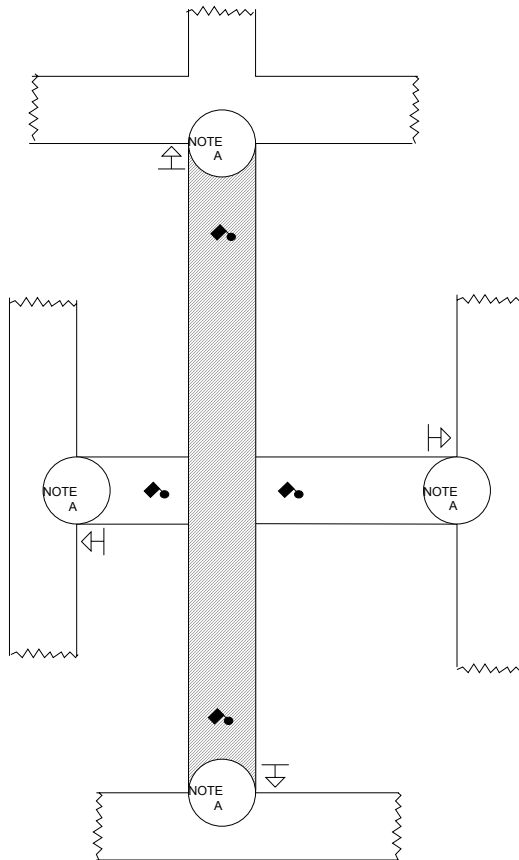
MULTILANE, DIVIDED, FIXED WORK SITE DAY OR NIGHT OPERATIONS

Where, at any time, any vehicle, equipment, worker or their activities will encroach in the area between the centerline and the outside edge of the pavement.

General Notes

1. All vehicles, equipment, workers (except flagger) and their activities are restricted at all times to one side of the pavement, unless otherwise authorized by the Traffic Engineer.
2. The "L" distance equals the lane width times the posted speed limit.
3. This case also applies when work is being performed in the lane adjacent to the median of a divided highway. Under these conditions a left lane closed sign will be substituted for the right lane closed sign. Also, a merge right sign will be substituted for the keep left sign.
4. This case does not apply when work is being performed in the middle lane(s) of a six or more lane highway. Special plans, approved by the Engineer, will be required.
5. Cones may be substituted for drums during day operations. Traffic cones shall be a minimum of 28 inches in height.
6. A minimum of two (2) AMBER, TYPE B, high-intensity flashing warning lights shall be used at night in advance of the work area. One (1) AMBER flashing light shall be installed above each of the first two (2) advance warning signs in the series. (Both sides of Road).
7. Drums shall be equipped with one (1) amber Type "B" flashing lights at the point of hazard. One (1) amber Type "B" flashing lights shall be used on the first two(2) Drums in the series for delineation. Drums used on tapers shall be placed at approximately right angles to the traffic flow and at not more than 25 ft. intervals for the first four (4) Drums and at not more than 50 ft. intervals for all others required.
8. All signs shall be post mounted if closure time exceeds four (4) days, unless otherwise authorized by the Traffic Engineer.
9. Longitudinal dimensions may be adjusted slightly to fit field conditions.
10. When a side road intersects the highway on which work is being performed, additional traffic control devices shall be erected as directed by the Engineer.
11. This is the minimum requirement for the condition set forth. The Traffic Engineer may require additional traffic control devices as deemed necessary.
12. All vehicles in a work area shall display flashing lights installed for the purpose of warning approaching drivers of a vehicular traffic hazard requiring unusual care in approaching, overtaking, or passing.

STANDARD DESIGN
TYPICAL APPLICATION OF TRAFFIC CONTROL DEVICES FOR
HIGHWAY CONSTRUCTION, MAINTENANCE AND UTILITY OPERATIONS
CASE 21
MOVING OPERATIONS DAYTIME ONLY




BARRICADE SYMBOLS

 Type III

SYMBOLS

 Work area

 Sign (bottom of all signs must be at least (5) five feet above roadway surface)

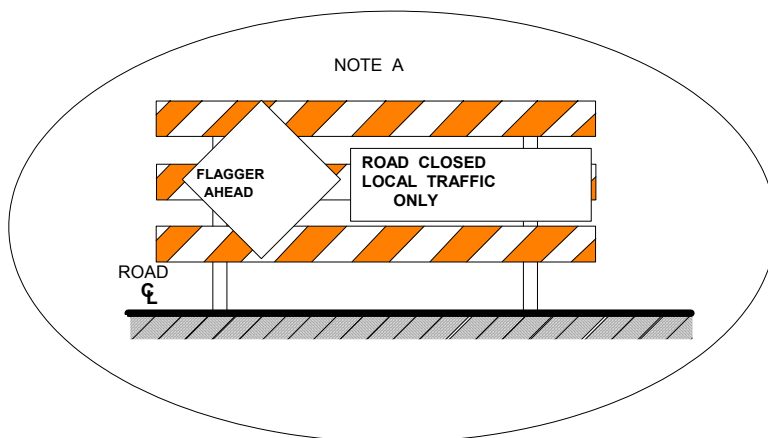
 Flagger station

TYPICAL APPLICATIONS

Bituminous Surface Treatment

Gas Leak

Haz. Mat. Spills



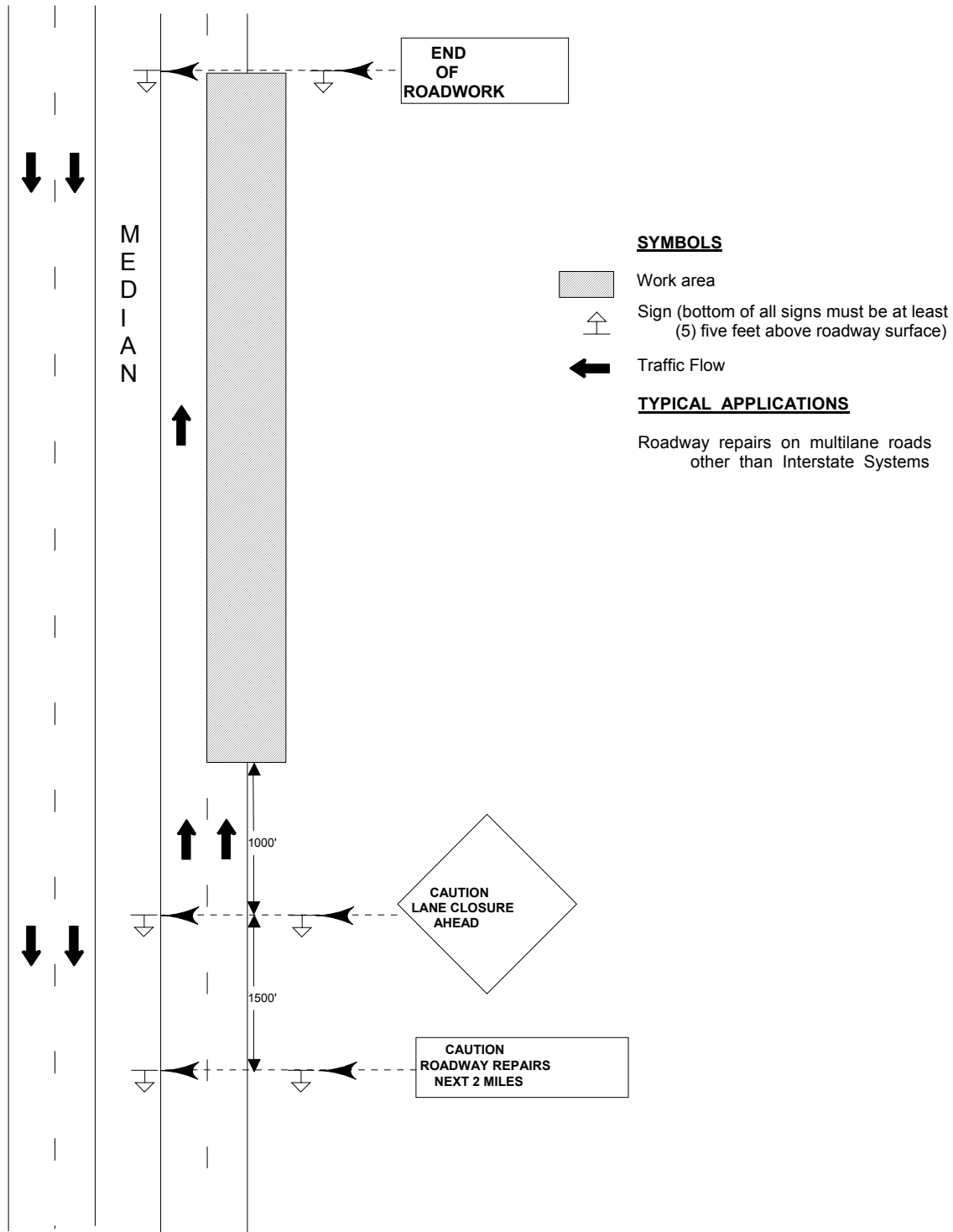
CASE 21

MOVING OPERATIONS - DAYTIME ONLY

General Notes

1. All vehicles, equipment, workers (except flagger) and their activities are restricted at all times to one traffic lane, leaving the opposite lane open to traffic.
2. No bituminous surface treatment operations shall be performed when due to insufficient light or unfavorable atmospheric conditions, persons and vehicles on the highway are not clearly discernible at a distance of 1,000 feet ahead.
3. The flaggers shall be in sight of each other or in communications at all times.
4. Flagger signs shall be displayed not less than 500 feet prior to the flagger station. The maximum distance to be determined by the Traffic Engineer, but in no case to exceed the length of one-half (1/2) days operation or two (2) miles, whichever is less.
5. The minimum distance requirements given in note #4 do not apply when the work operation starts or stops at the junction of a connecting road. In this event signs on the connecting road will be placed in accordance with Case 7-A.
6. Flagger ahead signs will be promptly removed at the cessation of work operations.
7. Drums illustrated in note A will be placed when work operation moves out of intersection and removed when road is opened to traffic in its entirety. Barricades on intersecting and side roads will be placed prior to start of work operations.
8. All vehicles in a work area shall display flashing lights installed for the purpose of warning approaching drivers of a vehicular traffic hazard requiring unusual care in approaching, overtaking, or passing.
9. This is the minimum requirement for the condition set forth. The Traffic Engineer may require additional traffic control devices as deemed necessary.

STANDARD DESIGN
TYPICAL APPLICATION OF TRAFFIC CONTROL DEVICES FOR
HIGHWAY CONSTRUCTION, MAINTENANCE AND UTILITY OPERATIONS
CASE 22
MULTILANE, DIVIDED, OR UNDIVIDED MOVING DAY OPERATIONS ONLY



CASE 22

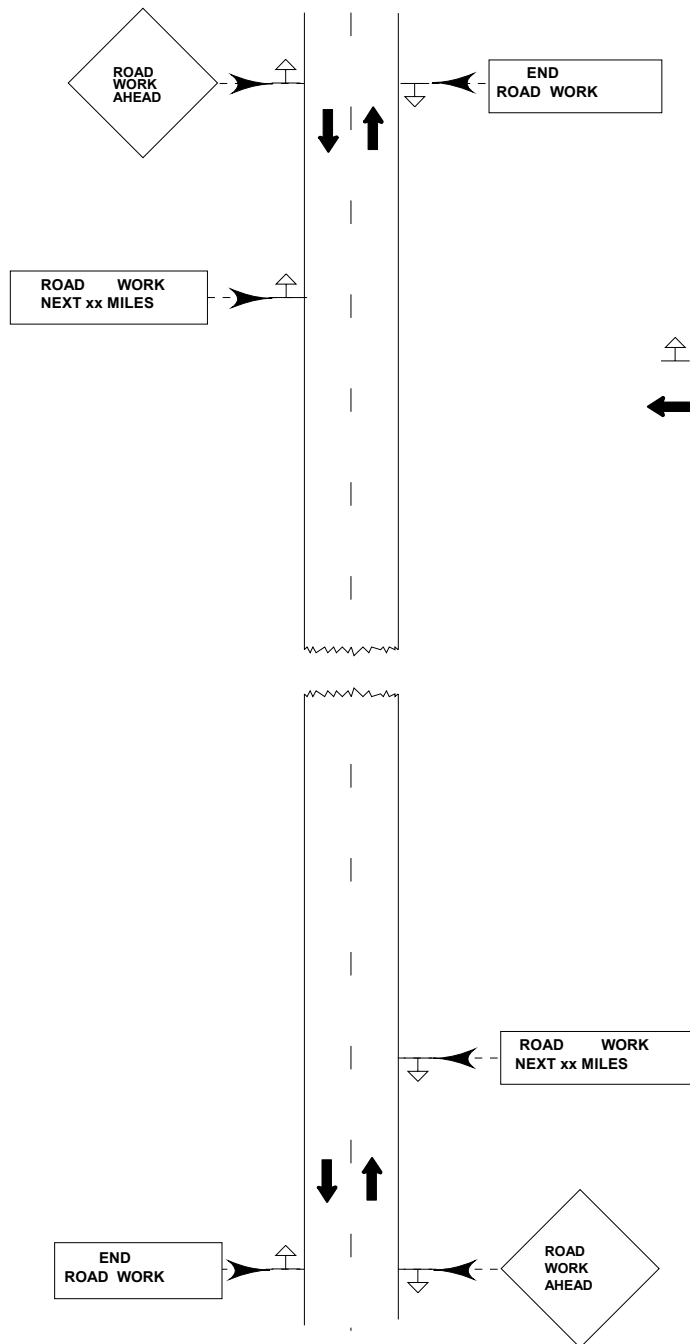
MULTILANE, DIVIDED OR UNDIVIDED MOVING DAY OPERATIONS ONLY

Where, at any time, any vehicle, equipment, workers or their activities require an intermittent or continuous moving operation in the area between the centerline and the outside edge of the travelway.

General Notes

1. 1500 feet prior to start of work area signs 48"x72" will be placed stating: Caution Roadway Repairs Next 2 Miles.
2. 1000 feet prior to start of work area, a sign 43"x 48" will be placed stating: FLAGGER AHEAD.
3. 500 feet prior to start of work area would be a truck with approved arrow panel. This vehicle would, at all times, be positioned in the lane that is closed to thru traffic and arrow panel must indicate lane open to traffic.
4. 100 feet prior to start of work location, a FLAGGER, properly attired, would be stationed to alert the workmen in the event a motorist does not appear to be conforming to the desired traffic pattern. FLAGGER shall not attempt to control traffic unless FLAGGER warning signs are displayed in accordance with instructions found elsewhere in this manual.
5. Strobe lights are required on all equipment participating in patching operation or required to be at work site.
6. All personnel working in or near the roadway must wear "orange" vests and protective headgear to identify them as being part of a "construction, maintenance or utility work force". FLAGGER must adhere to the standard FLAGGER procedures.
7. When moving from one location to another, all vehicles will travel on shoulder whenever possible.
8. Workers and equipment are confined to one (1) lane leaving the adjacent lane open to traffic.
9. The work area shall not exceed two (2) miles or one-half (1/2) day's operation, whichever is less.
10. When a side road intersects the highway on which work is being performed, additional traffic control devices are required.
11. This is the minimum requirement for the condition set forth. The Traffic Engineer may require additional traffic control devices as deemed necessary.
12. Truck mounted attenuators (T.M.A.) shall be used before work area, unless otherwise authorized by the Engineer.

STANDARD DESIGN
TYPICAL APPLICATION OF TRAFFIC CONTROL DEVICES FOR
HIGHWAY CONSTRUCTION, MAINTENANCE AND UTILITY OPERATIONS
CASE 23
ADVANCE WARNING SIGNS FOR TWO-LANE, TWO-WAY OR MULTILANE
TRAFFIC, DAY OR NIGHT OPERATIONS



SYMBOLS



Sign (bottom of all signs must be at least (5) five feet above roadway surface)



Traffic Flow

TYPICAL APPLICATIONS

Advance warning signs for rural or urban use during road construction or reconstruction

CASE 23

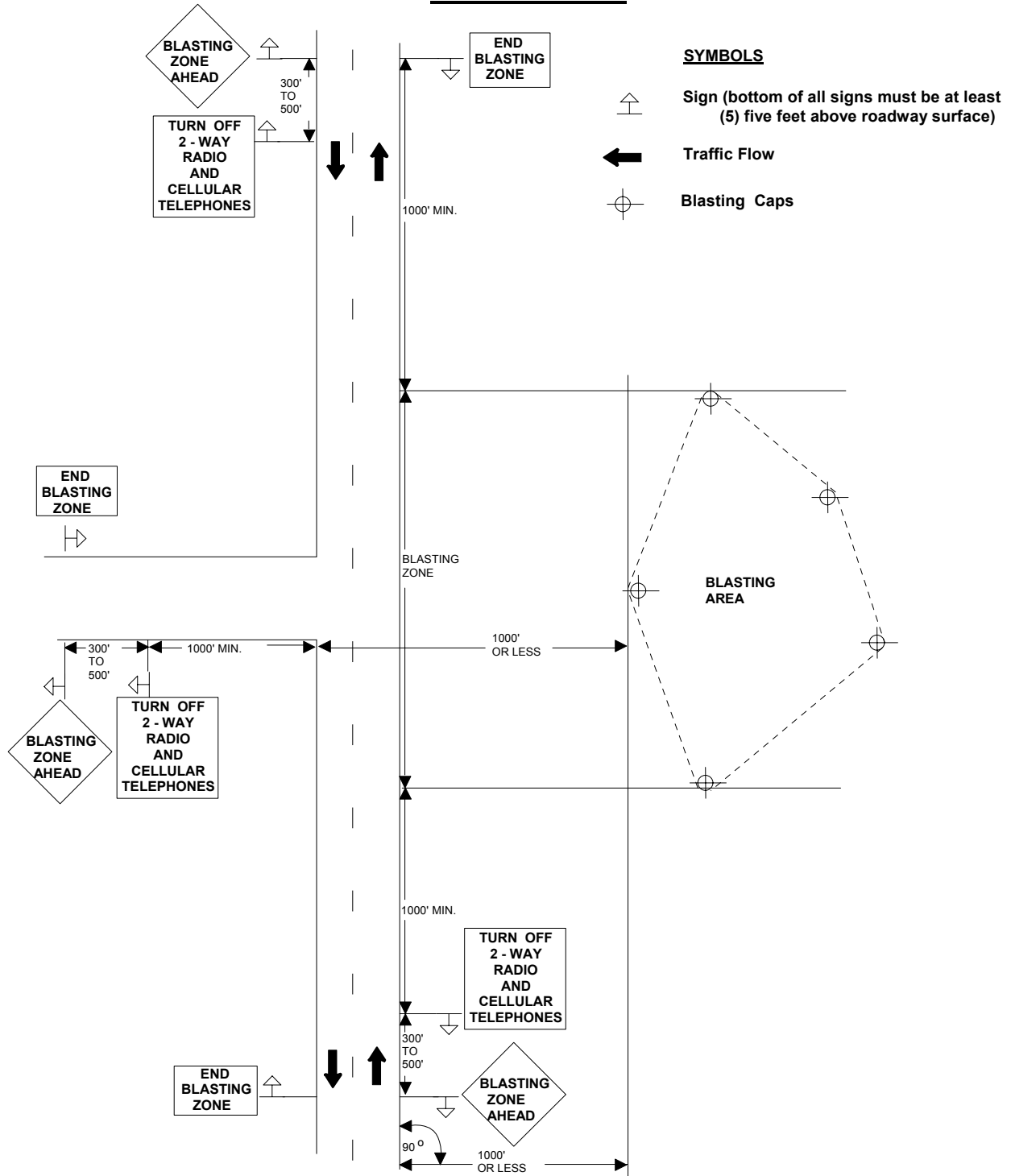
ADVANCE WARNING SIGNS FOR TWO-LANE, TWO-WAY OR MULTILANE TRAFFIC, DAY OR NIGHT OPERATIONS

Where length of construction is more than two (2) miles in extent and traffic is maintained through the job sites, these signs may also be used where required for jobs of lesser length with appropriate distances shown.

General Notes

1. All signs shall be post mounted unless otherwise authorized by the Traffic Engineer.
2. When used at night the first advance warning sign in the series approaching a work zone shall display one (1) Type "B" Amber light and the second advance warning sign in the series approaching a work zone shall display two (2) Type "B" Amber lights.
3. For divided highways signs shall be displayed on both right and left sides of the roadway.
4. This CASE also applies when work is being performed on a multi-lane undivided highway. Under these conditions the signs normally mounted in the median shall be omitted.
5. The use of the advance warning signs "ROAD WORK AHEAD" and "ROAD WORK NEXT XX MILES" shall not alter any other requirements for the use of traffic control devices as set forth in the provisions given elsewhere in this Manual.
6. This is the minimum requirement for the condition set forth. The Traffic Engineer may require additional traffic control devices as deemed necessary.

STANDARD DESIGN
TYPICAL APPLICATION OF TRAFFIC CONTROL DEVICES FOR
HIGHWAY CONSTRUCTION, MAINTENANCE AND UTILITY OPERATIONS
CASE 24
BLASTING ZONE



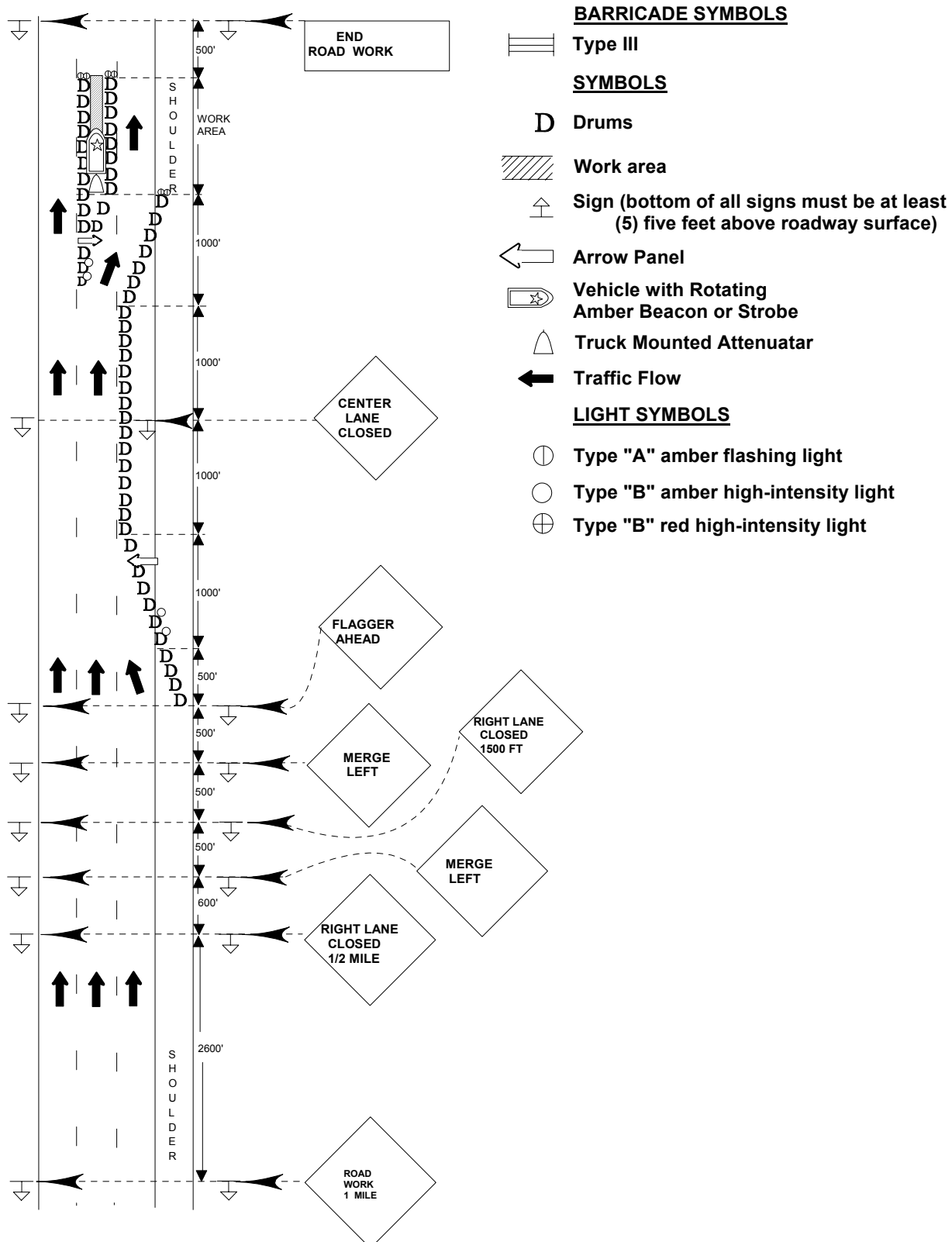
CASE 24

BLASTING ZONE

General Notes

1. Whenever blasting caps are used within 1,000 feet of a roadway, the appropriate signing is required. On a divided highway, the signs shall be dual mounted on both roadways.
2. The signs shall be covered or removed when there are no explosives in the area or the area is otherwise secure.
3. Whenever a side road intersects the roadway between the "Blasting Zone Ahead" sign and the "End Blasting Zone" sign or a side road is within 1,000 feet of any blasting cap, similar signing, as on the mainline, shall be erected on the side road.
4. Prior to blasting, the blaster in charge shall determine whatever highway traffic in the blasting zone will be endangered by the blasting operator. If there is danger, highway traffic shall not be permitted to pass through the blasting zone during blasting operations.
5. This is the minimum requirement for the condition set forth. The Traffic Engineer may require additional traffic control devices as deemed necessary.

STANDARD DESIGN
TYPICAL APPLICATION OF TRAFFIC CONTROL DEVICES FOR
HIGHWAY CONSTRUCTION, MAINTENANCE AND UTILITY OPERATIONS
CASE 25
MULTI LANE LIMITED CONTROL FOR INTERSTATES AND HIGHWAYS
- HEAVY TRAFFIC



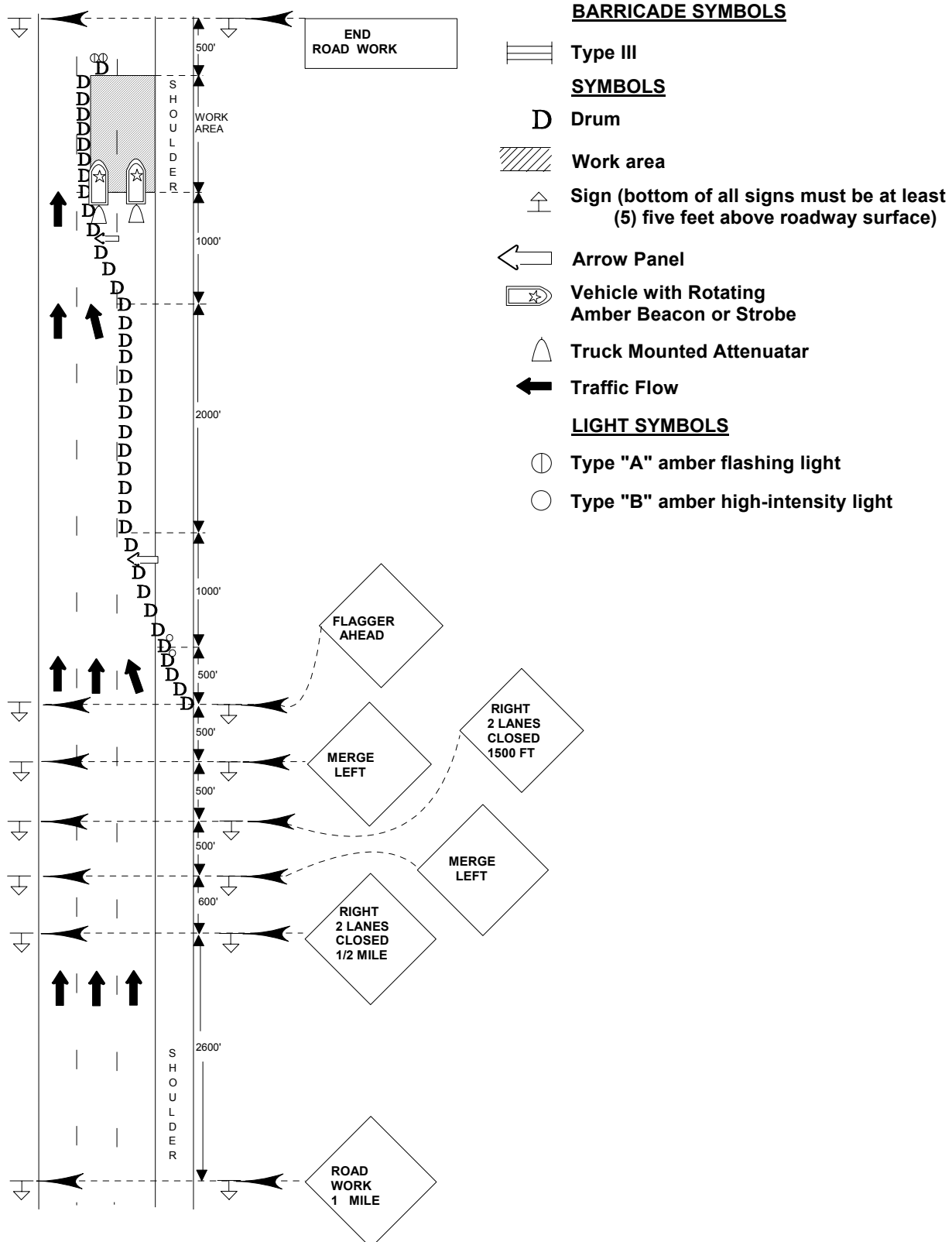
CASE 25

MULTILANE LIMITED CONTROL FOR INTERSTATES AND HIGHWAYS - HEAVY TRAFFIC

General Notes

1. All vehicles, equipment, workers (except FLAGGER) and their activities are restricted at all times to one side of the pavement, unless otherwise authorized by the Engineer.
2. The "L" distance is 1,000 feet.
3. All construction signs that are up over night shall have one (1) "B" amber warning light. Two (2) flags may be mounted on each sign if authorized by the Engineer. Flags shall be a 24" x 24" minimum on a 3 foot standard.
4. The FLAGGER shall use a stop/slow paddle.
5. Cones may be substituted for plastic drums during daytime operation.
6. Drums used on taper shall be placed at approximate right angles to the traffic flow and not more than 25 feet intervals for the first eight (8) Drums and not more than 50 feet intervals for all required.
7. Longitudinal dimensions may be adjusted slightly to fit field condition when approved by the Engineer.
8. When ramp or side roads intersect the highway on which work is being performed, additional traffic control devices shall be erected as directed by the Engineer.
9. All vehicles in the work area shall display flashing lights, installed for the purpose of warning approaching drivers of a vehicular traffic hazard requiring unusual care in approaching, overtaking or passing.
10. Truck mounted attenuators (T.M.A.) shall be used before work area, unless otherwise authorized by the Engineer.
11. Drums shall be equipped with one (1) amber type "B" flashing lights at the point of hazard. One(1) amber type "B" flashing lights shall be used on the first two(2) Drums in the series for delineation.
12. This is the minimum requirement for the condition set forth. The Traffic Engineer may require additional traffic control devices as deemed necessary.

STANDARD DESIGN
TYPICAL APPLICATION OF TRAFFIC CONTROL DEVICES FOR
HIGHWAY CONSTRUCTION, MAINTENANCE AND UTILITY OPERATIONS
CASE 26
MULTI LANE LIMITED CONTROL FOR INTERSTATES AND HIGHWAYS
- LIGHT TRAFFIC



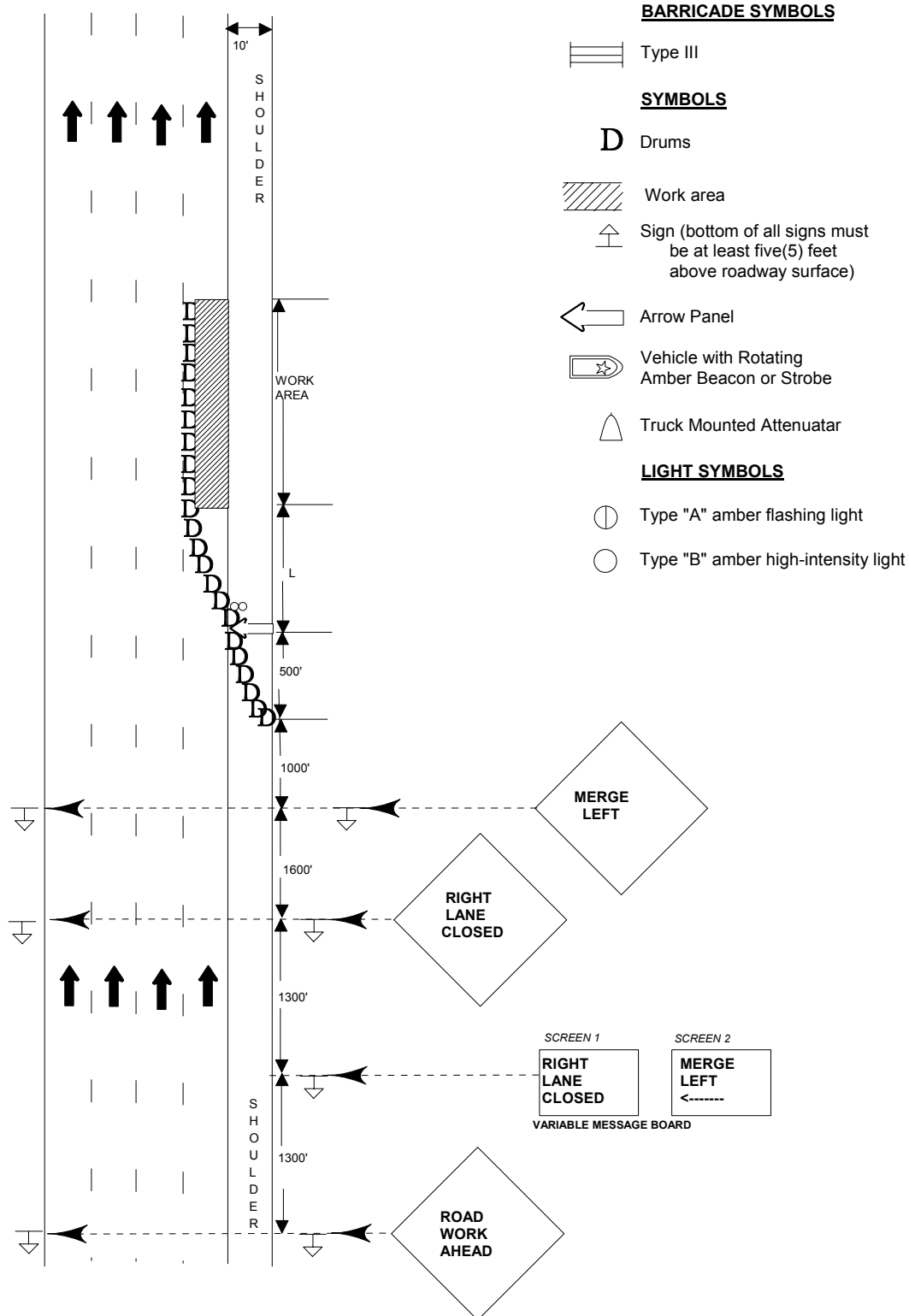
CASE 26

MULTILANE LIMITED CONTROL FOR INTERSTATES AND HIGHWAYS - LIGHT TRAFFIC

General Notes

1. All vehicles, equipment, workers (except FLAGGER) and their activities are restricted at all times to one side of the pavement, unless otherwise authorized by the Engineer.
2. The "L" distance is 1,000 feet.
3. All construction signs that are up over night shall have one (1) "B" amber warning light. Two (2) flags may be mounted on each sign if authorized by the Engineer. Flags shall be a 24" x 24" minimum on a 3 foot standard.
4. The FLAGGER shall use a stop/slow paddle.
5. Cones may be substituted for plastic drums during daytime operation or for emergency operations of less than 48 hours.
6. Drums used on taper shall be placed at approximate right angles to the traffic flow and not more than 25 feet intervals for the first eight (8) Drums and not more than 50 feet intervals for all required.
7. Longitudinal dimensions may be adjusted slightly to fit field condition when approved by the Engineer.
8. When ramp or side roads intersect the highway on which work is being performed, additional traffic control devices shall be erected as directed by the Engineer.
9. All vehicles in the work area shall display flashing lights, installed for the purpose of warning approaching drivers of a vehicular traffic hazard requiring unusual care in approaching, overtaking or passing.
10. Truck mounted attenuators (T.M.A.) shall be used before work area, unless otherwise authorized by the Engineer.
11. Drums shall be equipped with one (1) amber type "B" flashing lights at the point of hazard. One (1) amber type "B" flashing lights shall be used on the first two(2) Drums in the series for delineation.
12. This is the minimum requirement for the condition set forth. The Traffic Engineer may require additional traffic control devices as deemed necessary.
13. When insufficient median width exists to post left side signs, additional signs shall be posted on the right side as directed by the Traffic Engineer.

STANDARD DESIGN
TYPICAL APPLICATION OF TRAFFIC CONTROL DEVICES FOR
HIGHWAY CONSTRUCTION, MAINTENANCE AND UTILITY OPERATIONS
CASE 27
MULTI LANE LIMITED CONTROL FOR INTERSTATES AND HIGHWAYS
SHORT DURATION (LESS THAN A DAY)



CASE 27

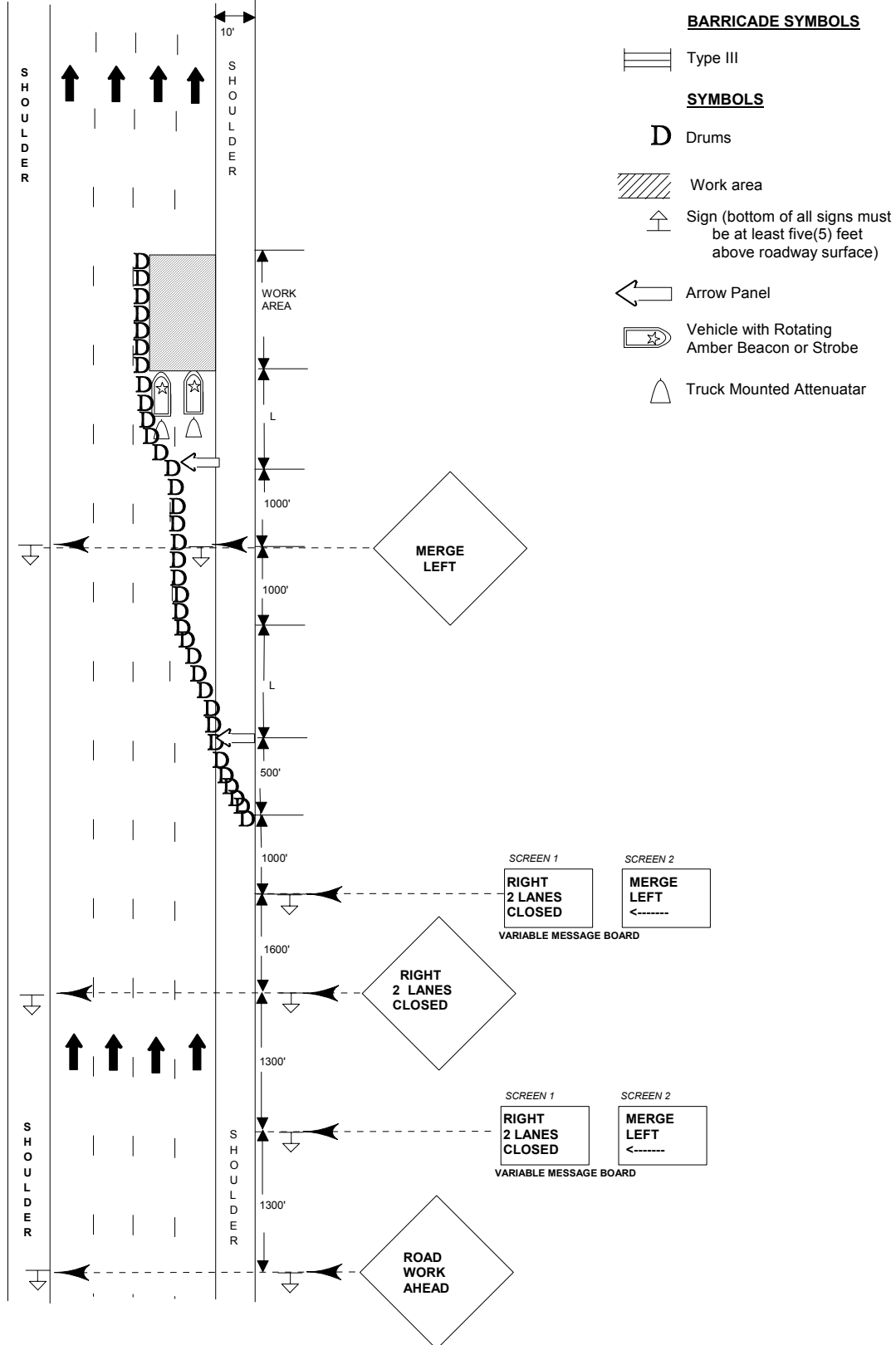
MULTILANE LIMITED CONTROL FOR INTERSTATES AND HIGHWAYS SHORT DURATION (LESS THAN A DAY)

General Notes

1. All vehicles, equipment, workers (except FLAGGER) and their activities are restricted at all times to one side of the pavement, unless otherwise authorized by the Engineer.
2. The "L" distance is 1,000 feet.
3. Cones may be substituted for plastic drums during daytime operation or for emergency operations of less than 48 hours.
4. Drums used on taper shall be placed at approximate right angles to the traffic flow and not more than 25 feet intervals for the first eight (8) Drums and not more than 50 feet intervals for all required.
5. Longitudinal dimensions may be adjusted slightly to fit field condition when approved by the Engineer.
6. When ramp or side roads intersect the highway on which work is being performed, additional traffic control devices shall be erected as directed by the Engineer.
7. All vehicles in the work area shall display flashing lights, installed for the purpose of warning approaching drivers of a vehicular traffic hazard requiring unusual care in approaching, overtaking or passing.
8. Truck mounted attenuators (T.M.A.) shall be used before work area, unless otherwise authorized by the Engineer.
9. Drums shall be equipped with one (1) amber type "B" flashing lights at the point of hazard. One (1) amber type "B" flashing lights shall be used on the first two(2) Drums in the series for delineation.
10. This is the minimum requirement for the condition set forth. The Traffic Engineer may require additional traffic control devices as deemed necessary.

STANDARD DESIGN
TYPICAL APPLICATION OF TRAFFIC CONTROL DEVICES FOR
HIGHWAY CONSTRUCTION, MAINTENANCE AND UTILITY OPERATIONS
CASE 28

MULTI LANE LIMITED CONTROL FOR INTERSTATES AND HIGHWAYS
SHORT DURATION (LESS THAN A DAY)



CASE 28

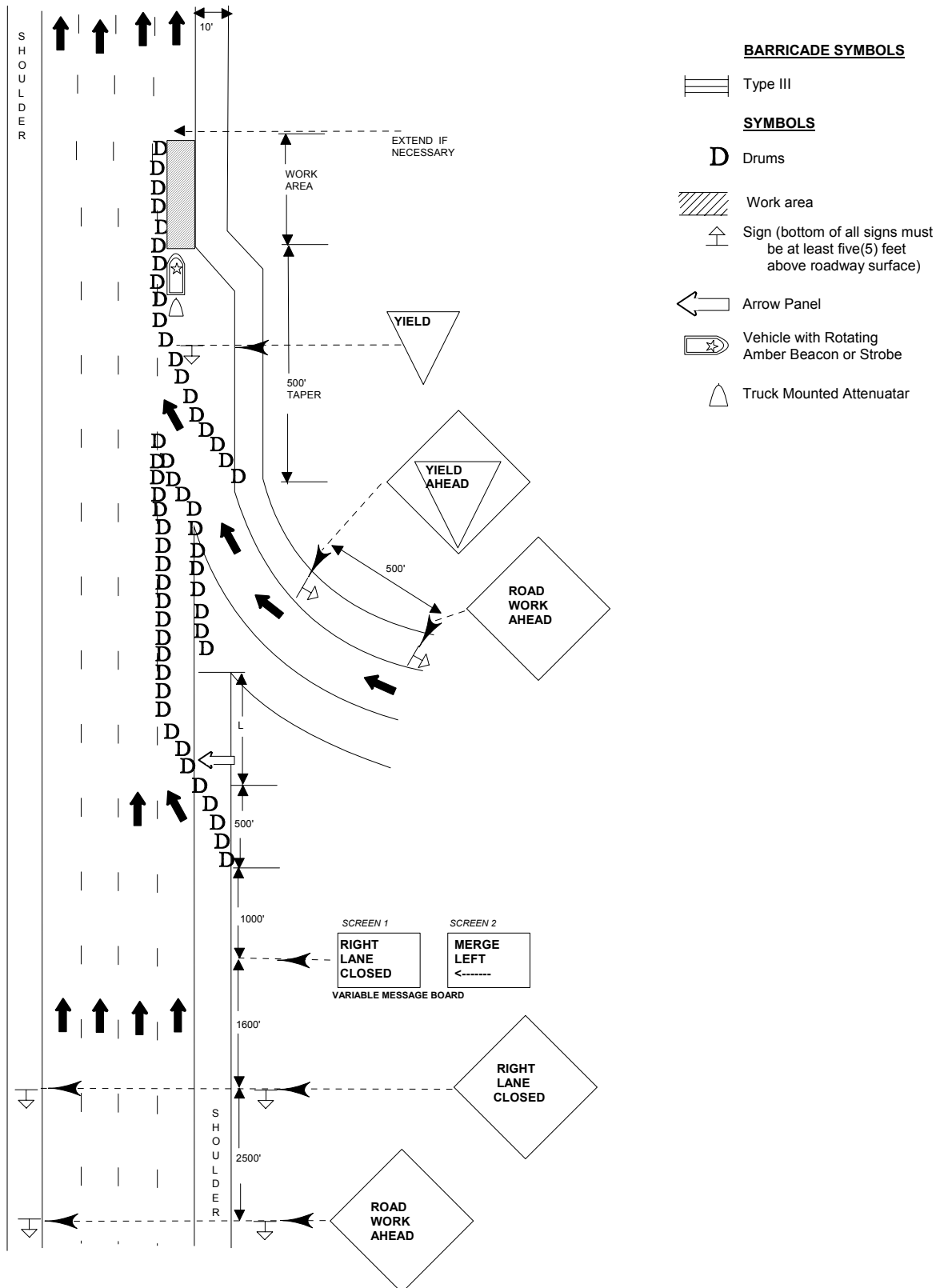
MULTILANE LIMITED CONTROL FOR INTERSTATES AND HIGHWAYS - LIGHT TRAFFIC

General Notes

1. All vehicles, equipment, workers (except FLAGGER) and their activities are restricted at all times to one side of the pavement, unless otherwise authorized by the Engineer.
2. The "L" distance is 1,000 feet.
3. Cones may be substituted for plastic drums during daytime operation or for emergency operations of less than 48 hours.
4. Drums used on taper shall be placed at approximate right angles to the traffic flow and not more than 25 feet intervals for the first eight (8) Drums and not more than 50 feet intervals for all required.
5. Longitudinal dimensions may be adjusted slightly to fit field condition when approved by the Engineer.
6. When ramp or side roads intersect the highway on which work is being performed, additional traffic control devices shall be erected as directed by the Engineer.
7. All vehicles in the work area shall display flashing lights, installed for the purpose of warning approaching drivers of a vehicular traffic hazard requiring unusual care in approaching, overtaking or passing.
8. Truck mounted attenuators (T.M.A.) shall be used before work area, unless otherwise authorized by the Engineer.
9. Drums shall be equipped with one (1) amber type "B" flashing lights at the point of hazard. One (1) amber type "B" flashing lights shall be used on the first two(2) Drums in the series for delineation.
10. This is the minimum requirement for the condition set forth. The Traffic Engineer may require additional traffic control devices as deemed necessary.

STANDARD DESIGN
TYPICAL APPLICATION OF TRAFFIC CONTROL DEVICES FOR
HIGHWAY CONSTRUCTION, MAINTENANCE AND UTILITY OPERATIONS
CASE 29

MULTI LANE LIMITED CONTROL FOR INTERSTATES AND HIGHWAYS
SHORT DURATION (LESS THAN A DAY) ON RAMP BEFORE WORK AREA



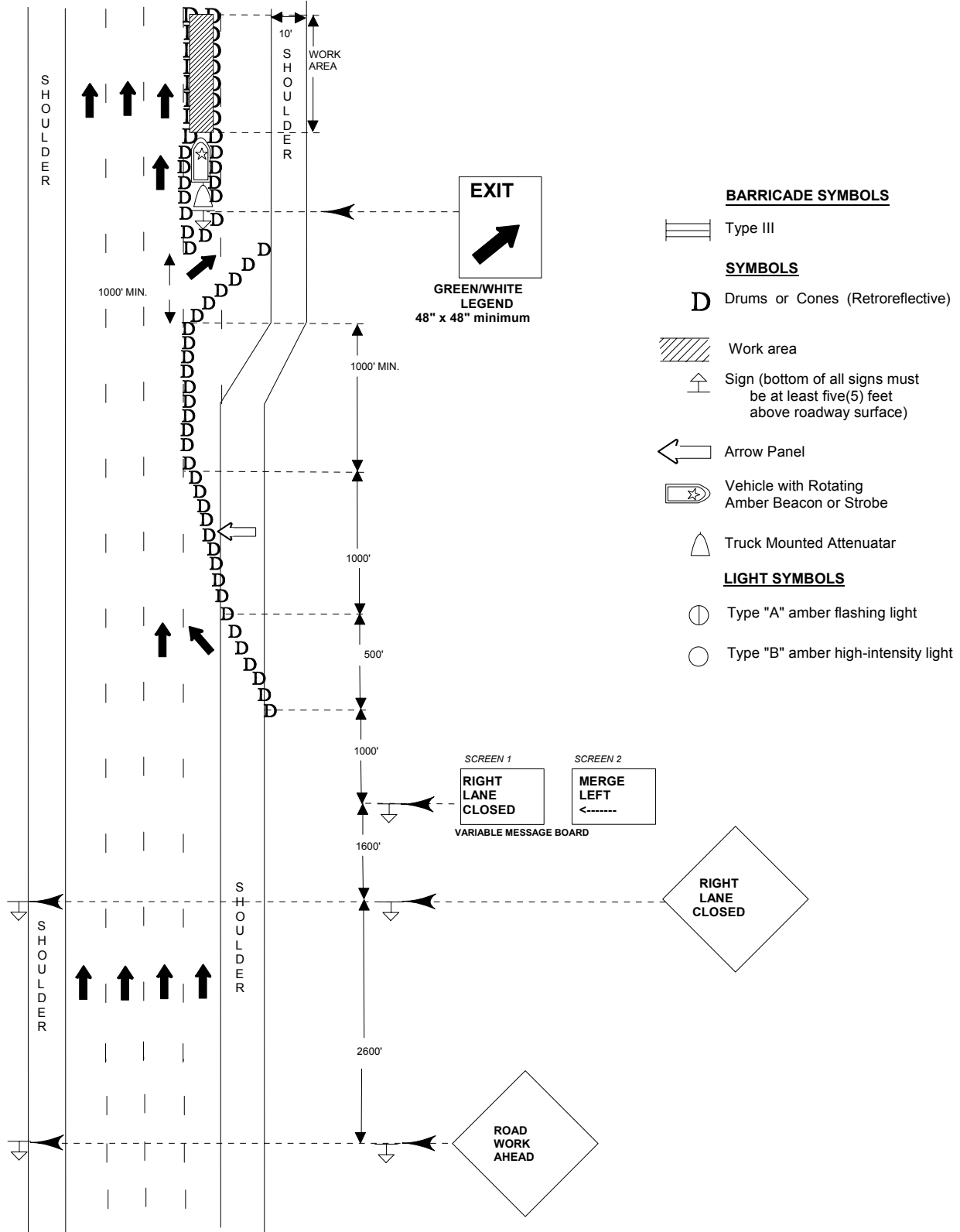
CASE 29

MULTILANE LIMITED CONTROL FOR INTERSTATES AND HIGHWAYS SHORT DURATION (LESS THAN A DAY)- ON RAMP BEFORE WORK AREA

General Notes

1. All vehicles, equipment, workers (except FLAGGER) and their activities are restricted at all times to one side of the pavement, unless otherwise authorized by the Engineer.
2. The "L" distance is 1,000 feet.
3. Cones may be substituted for plastic drums during daytime operation or for emergency operations of less than 48 hours.
4. Drums used on taper shall be placed at approximate right angles to the traffic flow and not more than 25 feet intervals for the first eight (8) Drums and not more than 50 feet intervals for all required.
5. Longitudinal dimensions may be adjusted slightly to fit field condition when approved by the Engineer.
6. All vehicles in the work area shall display flashing lights, installed for the purpose of warning approaching drivers of a vehicular traffic hazard requiring unusual care in approaching, overtaking or passing.
7. Truck mounted attenuators (T.M.A.) shall be used before work area, unless otherwise authorized by the Engineer.
8. Drums shall be equipped with one (1) amber type "B" flashing lights at the point of hazard. One (1) amber type "B" flashing lights shall be used on the first two(2) Drums in the series for delineation.
9. This is the minimum requirement for the condition set forth. The Traffic Engineer may require additional traffic control devices as deemed necessary.

STANDARD DESIGN
TYPICAL APPLICATION OF TRAFFIC CONTROL DEVICES FOR
HIGHWAY CONSTRUCTION, MAINTENANCE AND UTILITY OPERATIONS
CASE 30
MULTI LANE LIMITED CONTROL FOR INTERSTATES AND HIGHWAYS
SHORT DURATION - OFF RAMP BEFORE WORK AREA - LESS THAN A DAY



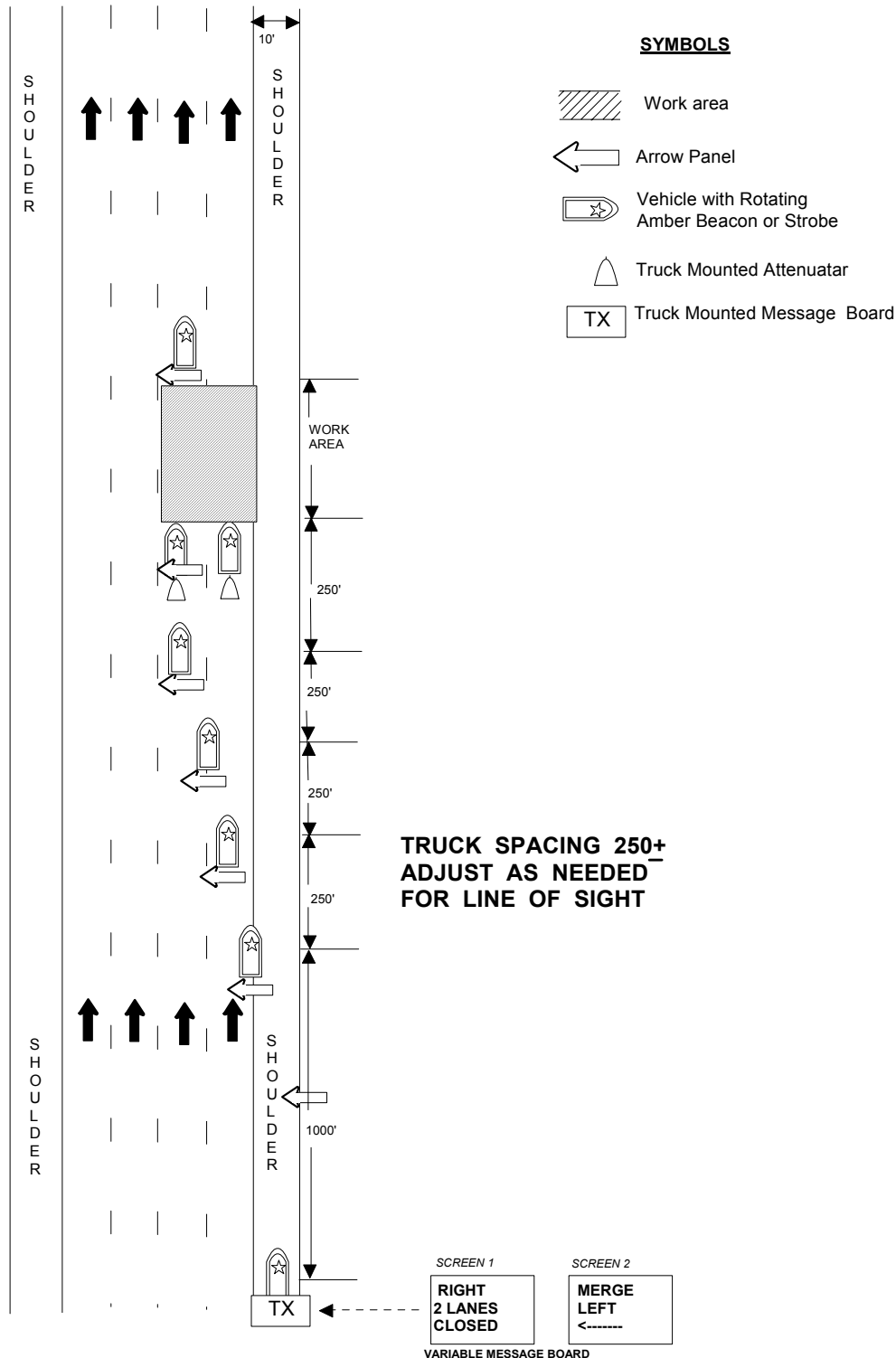
CASE 30

MULTILANE LIMITED CONTROL FOR INTERSTATES AND HIGHWAYS - LIGHT TRAFFIC

General Notes

1. All vehicles, equipment, workers (except FLAGGER) and their activities are restricted at all times to one side of the pavement, unless otherwise authorized by the Engineer.
2. The "L" distance is 1,000 feet.
3. Cones may be substituted for plastic drums during daytime operation or for emergency operations of less than 48 hours.
4. Drums used on taper shall be placed at approximate right angles to the traffic flow and not more than 25 feet intervals for the first eight (8) Drums and not more than 50 feet intervals for all required.
5. Longitudinal dimensions may be adjusted slightly to fit field condition when approved by the Engineer.
6. When ramp or side roads intersect the highway on which work is being performed, additional traffic control devices shall be erected as directed by the Engineer.
7. All vehicles in the work area shall display flashing lights, installed for the purpose of warning approaching drivers of a vehicular traffic hazard requiring unusual care in approaching, overtaking or passing.
8. Truck mounted attenuators (T.M.A.) shall be used before work area, unless otherwise authorized by the Engineer.
9. Drums shall be equipped with one (1) amber type "B" flashing lights at the point of hazard. One (1) amber type "B" flashing lights shall be used on the first two(2) Drums in the series for delineation.
10. This is the minimum requirement for the condition set forth. The Traffic Engineer may require additional traffic control devices as deemed necessary.

STANDARD DESIGN
TYPICAL APPLICATION OF TRAFFIC CONTROL DEVICES FOR
HIGHWAY CONSTRUCTION, MAINTENANCE AND UTILITY OPERATIONS
CASE 31
MULTI LANE LIMITED CONTROL FOR INTERSTATES AND HIGHWAYS
FOR STOP & GO OR SLOW MOVING DETOURS



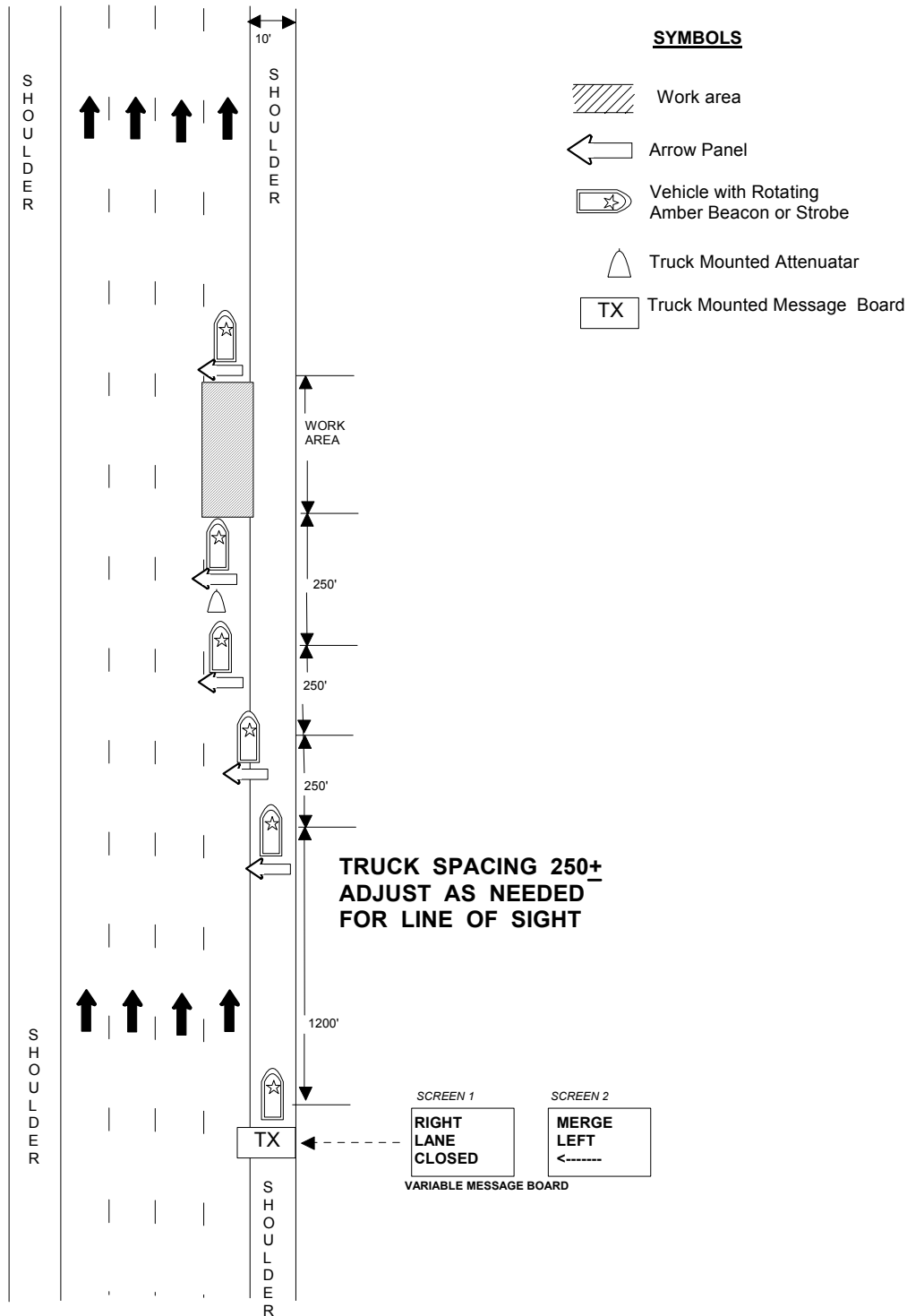
CASE 31

MULTILANE LIMITED CONTROL FOR INTERSTATES AND HIGHWAYS FOR STOP & GO OR SLOW MOVING TRAFFIC

General Notes

1. All vehicles, equipment, workers (except FLAGGER) and their activities are restricted at all times to one side of the pavement, unless otherwise authorized by the Engineer.
2. Longitudinal dimensions may be adjusted slightly to fit field condition when approved by the Engineer.
3. All vehicles in the work area shall display flashing lights, installed for the purpose of warning approaching drivers of a vehicular traffic hazard requiring unusual care in approaching, overtaking or passing.
4. Truck mounted attenuators (T.M.A.) shall be used before work area, unless otherwise authorized by the Engineer.
5. This is the minimum requirement for the condition set forth. The Traffic Engineer may require additional traffic control devices as deemed necessary.
6. Right lane TMA may be eliminated, if **NO** work or equipment is used in right lane, and there is no chance of a worker walking across the right lane to get to the shoulder.

STANDARD DESIGN
TYPICAL APPLICATION OF TRAFFIC CONTROL DEVICES FOR
HIGHWAY CONSTRUCTION, MAINTENANCE AND UTILITY OPERATIONS
CASE 32
MULTI LANE LIMITED CONTROL FOR INTERSTATES AND HIGHWAYS
FOR STOP & GO OR SLOW MOVING DETOURS



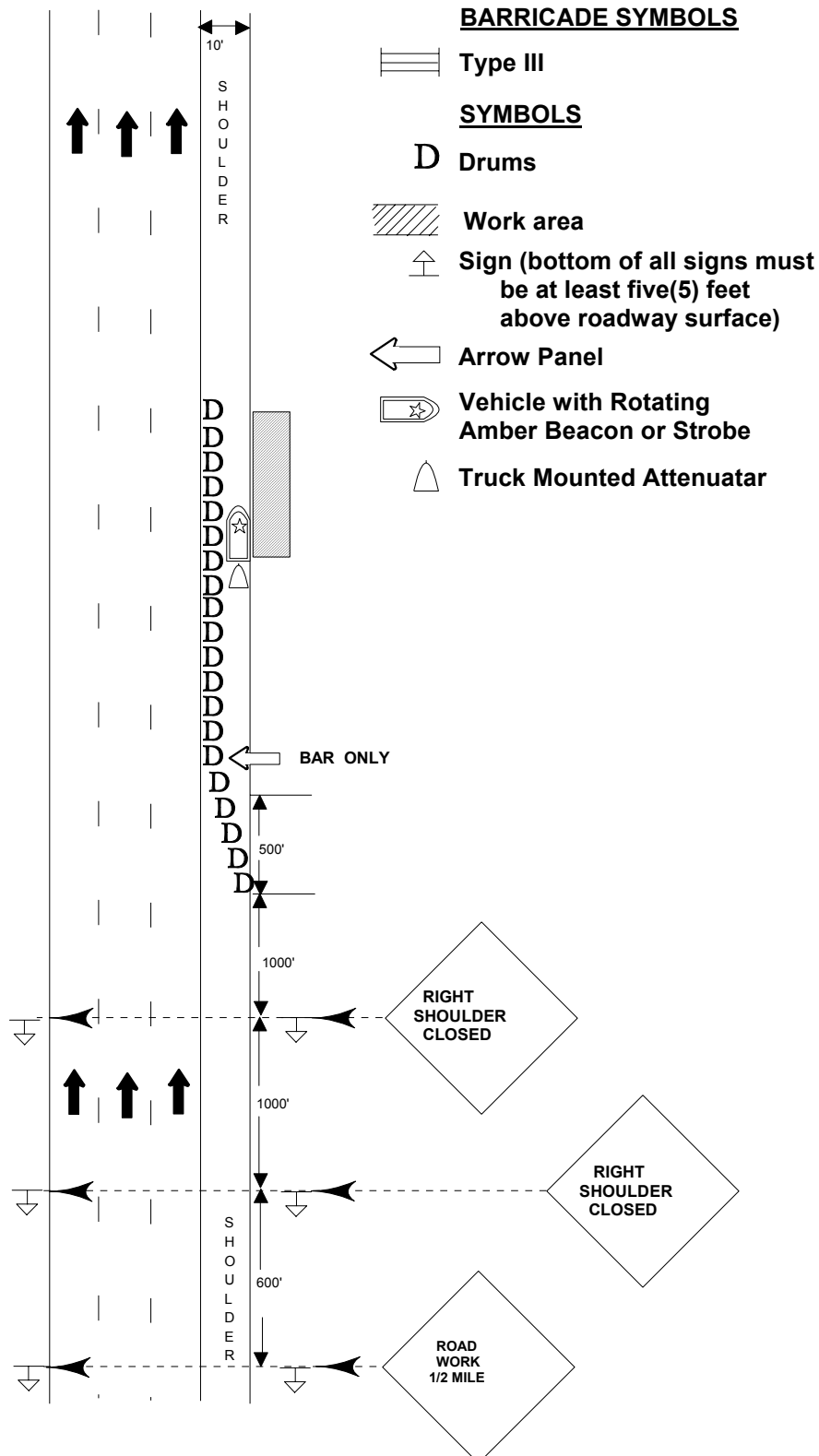
CASE 32

MULTILANE LIMITED CONTROL FOR INTERSTATES AND HIGHWAYS - LIGHT TRAFFIC

General Notes

1. All vehicles, equipment, workers (except FLAGGER) and their activities are restricted at all times to one side of the pavement, unless otherwise authorized by the Engineer.
2. Longitudinal dimensions may be adjusted slightly to fit field condition when approved by the Engineer.
3. All vehicles in the work area shall display flashing lights, installed for the purpose of warning approaching drivers of a vehicular traffic hazard requiring unusual care in approaching, overtaking or passing.
4. Truck mounted attenuators (T.M.A.) shall be used before work area, unless otherwise authorized by the Engineer.
5. This is the minimum requirement for the condition set forth. The Traffic Engineer may require additional traffic control devices as deemed necessary.

STANDARD DESIGN
TYPICAL APPLICATION OF TRAFFIC CONTROL DEVICES FOR
HIGHWAY CONSTRUCTION, MAINTENANCE AND UTILITY OPERATIONS
CASE 33
MULTI LANE LIMITED CONTROL FOR INTERSTATES AND HIGHWAYS
SHOULDER WORK - OFF SHOULDER



CASE 33

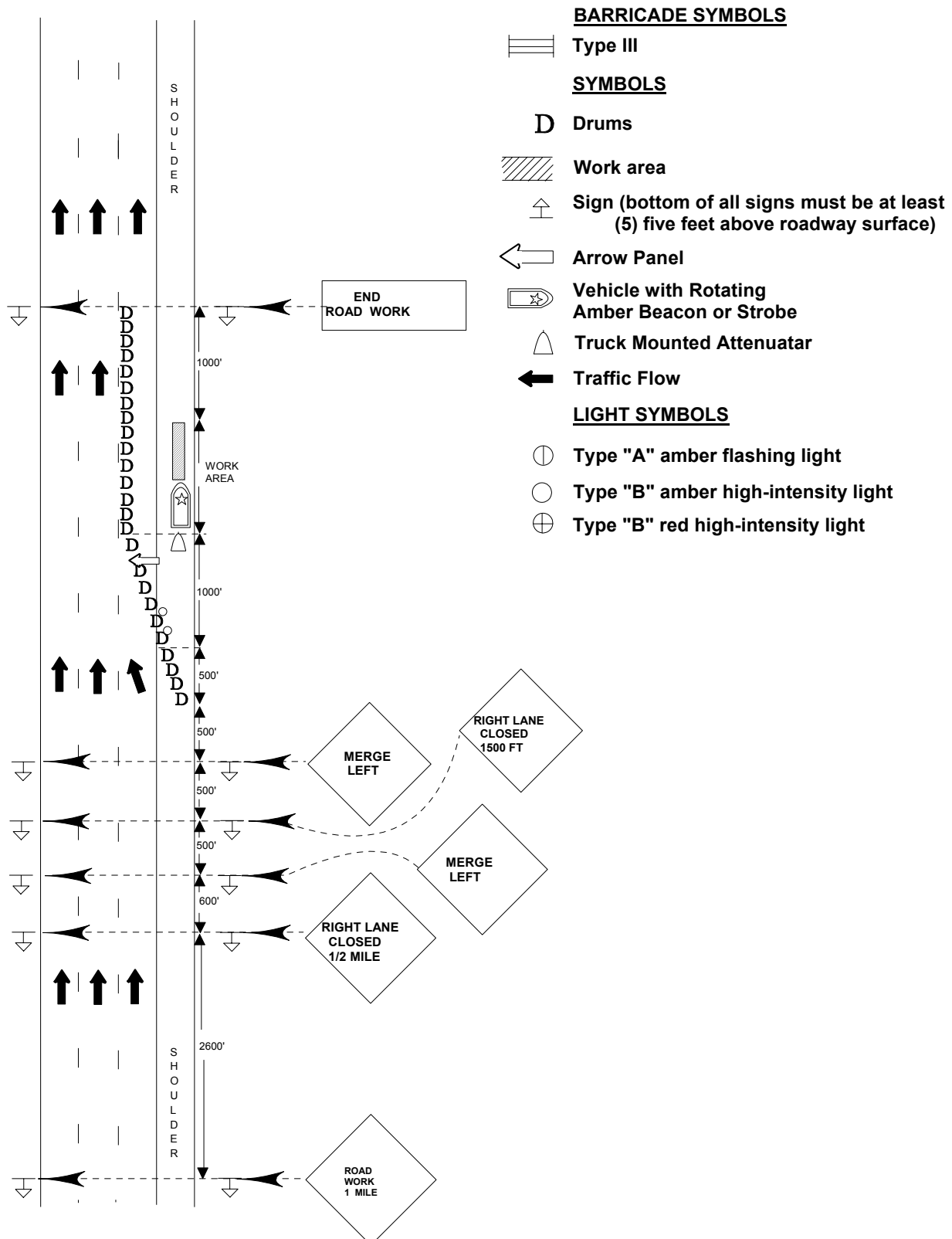
MULTILANE LIMITED CONTROL FOR INTERSTATES AND HIGHWAYS SHOULDER WORK - OFF SHOULDER

Where at all times, all vehicles, equipment, workers and their activities are more than the width of the shoulder from the edge of the roadway or pavement.

General Notes

1. This case also applies to work performed in the median more than 10 feet from either pavement.
2. All vehicles in a work area shall display flashing lights, installed for the purpose of warning approaching drivers of a vehicular traffic hazard requiring unusual care in approaching, overtaking or passing.
3. This is the minimum requirement for the condition set forth. The Traffic Engineer may require additional traffic control devices as deemed necessary.
4. Cones may be substituted for plastic drums during daytime operation or for emergency operations of less than 48 hours.
5. Warning Signs on the opposite side of the road from the work zone are not required, if the work zone is only for daylight hours with no shoulder restrictions during remaining hours.

STANDARD DESIGN
TYPICAL APPLICATION OF TRAFFIC CONTROL DEVICES FOR
HIGHWAY CONSTRUCTION, MAINTENANCE AND UTILITY OPERATIONS
CASE 33A
MULTI LANE LIMITED CONTROL FOR INTERSTATES AND HIGHWAYS
SHOULDER WORK - ON SHOULDER



CASE 33A

MULTILANE LIMITED CONTROL FOR INTERSTATES AND HIGHWAYS
SHOULDER WORK - ON SHOULDER

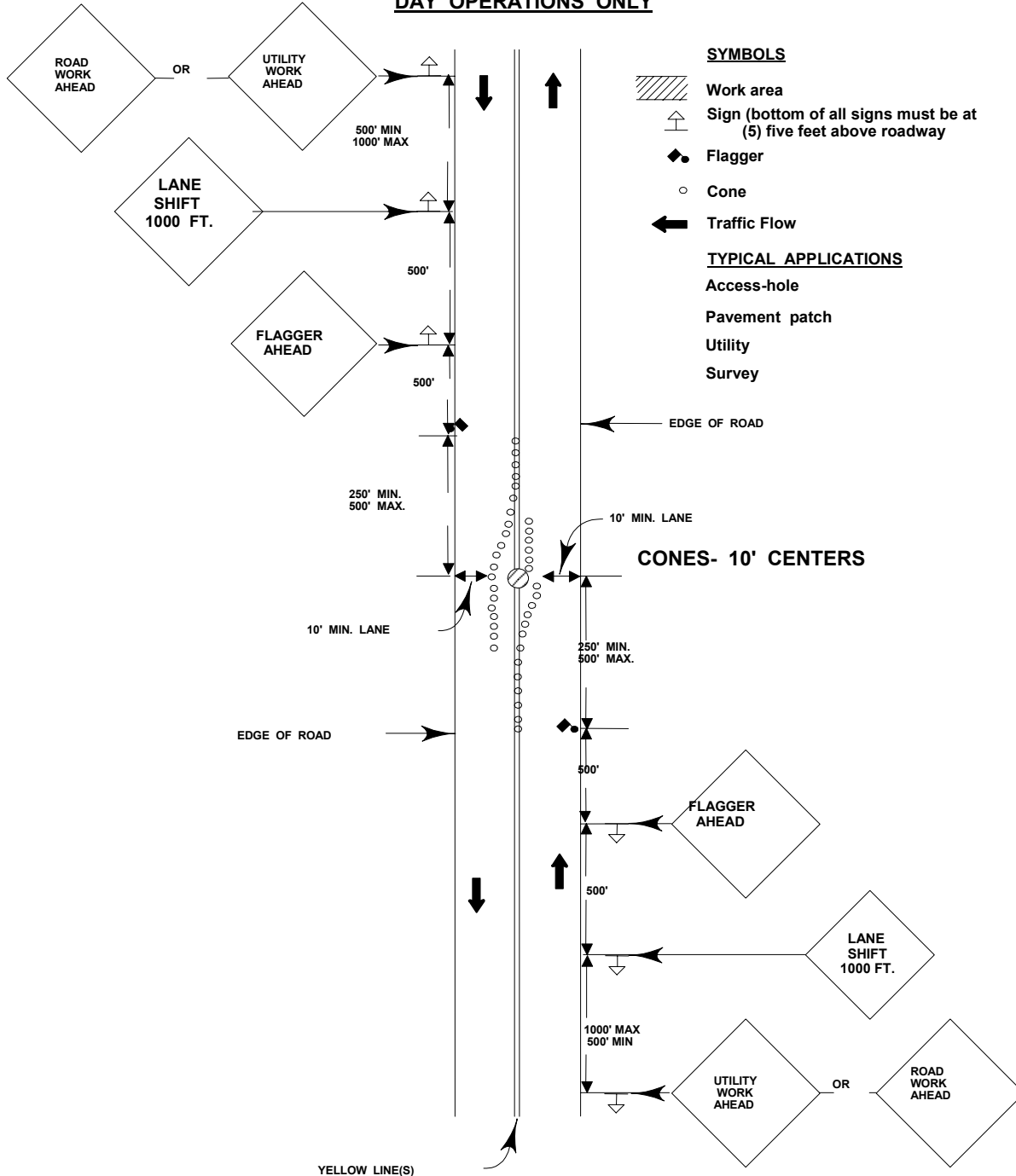
Where at all times, all vehicles, equipment, workers and their activities are within the shoulder. (Less than 10' feet from edge of travelway).

General Notes

1. This case also applies to work performed in the median less than 10 feet from either pavement.
2. All vehicles in a work area shall display flashing lights, installed for the purpose of warning approaching drivers of a vehicular traffic hazard requiring unusual care in approaching, overtaking or passing.
3. This is the minimum requirement for the condition set forth. The Traffic Engineer may require additional traffic control devices as deemed necessary.
4. Cones may be substituted for plastic drums during daytime operation or for emergency operations of less than 48 hours.
*
5. When the duration of the work is less than two hours, the work area is confined within the protected area of the TMA, and the shoulder has a minimum width of 10 feet.

**STANDARD DESIGN
TYPICAL APPLICATION OF TRAFFIC CONTROL DEVICES FOR
HIGHWAY CONSTRUCTION, MAINTENANCE AND UTILITY OPERATIONS
CASE 34**

**TWO-LANE, TWO-WAY TRAFFIC
DAY OPERATIONS ONLY**



CASE 34

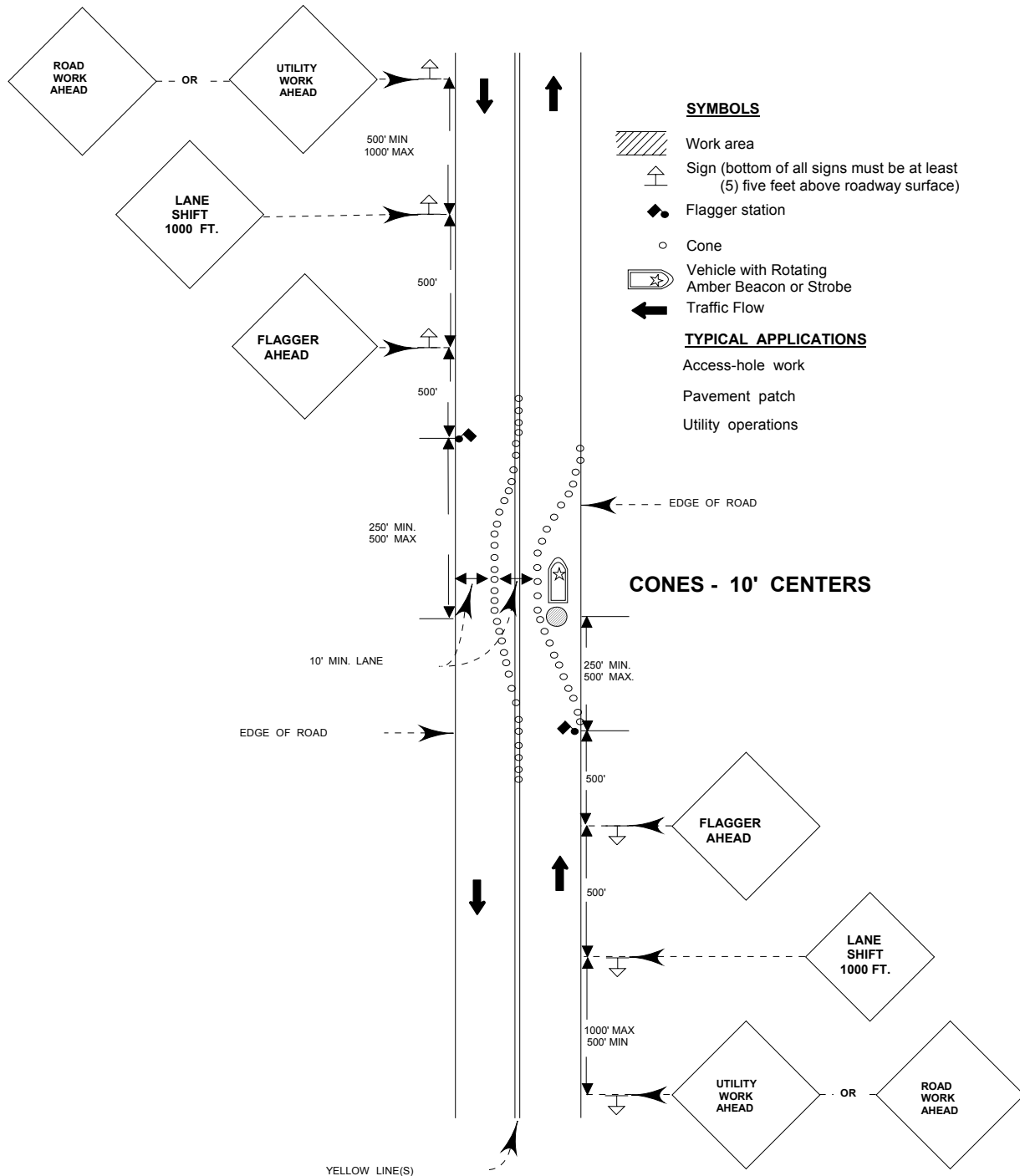
TWO-LANE, TWO-WAY or MULTILANE TRAFFIC SHORT TIME OPERATIONS DAY TIME ONLY

General Notes

1. All vehicles in a work area shall display flashing lights installed for the purpose of Warning approaching drivers of a vehicular traffic hazard requiring unusual care in approaching, overtaking, or passing.
2. All signs shall be removed at completion of the days operation.
3. Longitudinal dimensions may be adjusted slightly to fit field conditions.
4. All workers shall wear orange safety jacket.
5. The flagger shall be in sight of each other or in communication at all times.
6. When a side road intersects the highway on which work is being performed, additional traffic control devices shall be erected as directed by the traffic engineer.
7. This is the minimum requirements for the conditions set forth. The traffic engineer may require additional traffic control devices as deemed necessary.

**STANDARD DESIGN
TYPICAL APPLICATION OF TRAFFIC CONTROL DEVICES FOR
HIGHWAY CONSTRUCTION, MAINTENANCE AND UTILITY OPERATIONS**

**CASE 35
TWO-LANE, TWO-WAY TRAFFIC
DAY OPERATIONS ONLY**



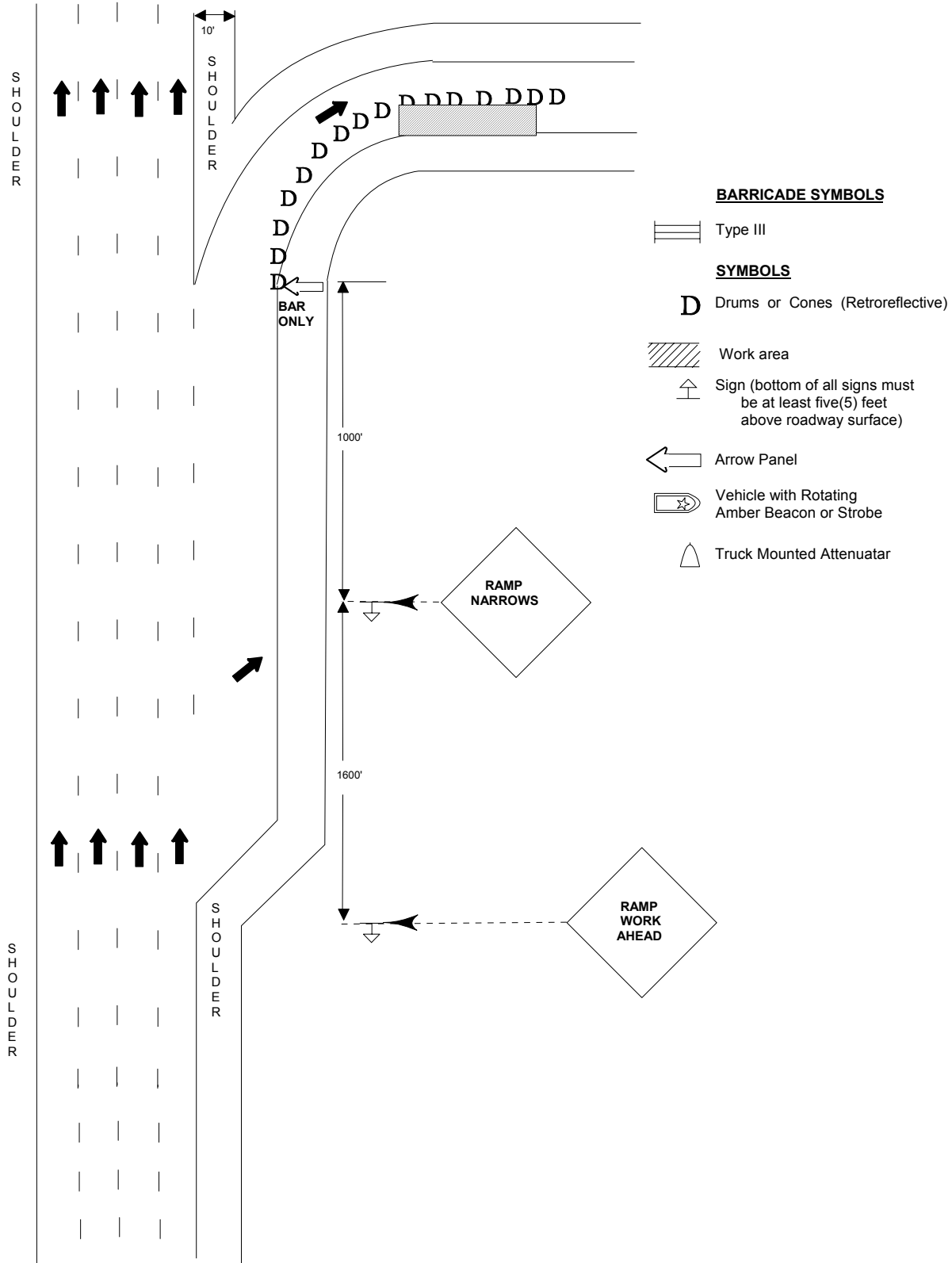
CASE 35

TWO-LANE, TWO-WAY or MULTILANE TRAFFIC SHORT TIME OPERATIONS DAY TIME ONLY

General Notes

1. All vehicles in a work area shall display flashing lights installed for the purpose of Warning approaching drivers of a vehicular traffic hazard requiring unusual care in approaching, overtaking, or passing.
2. All signs shall be removed at completion of the days operation.
3. Longitudinal dimensions may be adjusted slightly to fit field conditions.
4. All workers shall wear orange safety jacket.
5. The flagger shall be in sight of each other or in communication at all times.
6. When a side road intersects the highway on which work is being performed, additional traffic control devices shall be erected as directed by the traffic engineer.
7. This is the minimum requirements for the conditions set forth. The traffic engineer may require additional traffic control devices as deemed necessary.

STANDARD DESIGN
TYPICAL APPLICATION OF TRAFFIC CONTROL DEVICES FOR
HIGHWAY CONSTRUCTION, MAINTENANCE AND UTILITY OPERATIONS
CASE 36
MULTI LANE LIMITED CONTROL FOR INTERSTATES AND HIGHWAYS
WORK AREAS ON RAMP - DAYTIME OPERATIONS ONLY



CASE 36

MULTILANE LIMITED CONTROL FOR INTERSTATES AND HIGHWAYS
WORK AREAS ON RAMPS - DAY TIME OPERATIONS ONLY

General Notes

1. All vehicles in a work area shall display flashing lights installed for the purpose of Warning approaching drivers of a vehicular traffic hazard requiring unusual care in approaching, overtaking, or passing.
2. Cones or plastic drums may be used.
3. This is the minimum requirements for the conditions set forth. The traffic engineer may require additional traffic control devices as deemed necessary.